# THE LIFE AND LOVE OF THE INSECT

J. H. FABRE

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# THE LIFE AND LOVE OF THE INSECT

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1. The Sacred Beetle. 2. The Sacred Beetle rolling his pill.
3. Rolling the pill to the eating burrow.

# THE LIFE AND LOVE OF THE INSECT

BY

J. HENRI FABRE

TRANSLATED BY

ALEXANDER TEIXEIRA DE MATTOS

LONDON
ADAM AND CHARLES BLACK
1911

## TRANSLATOR'S NOTE

THE author of these essays was born at Sérignan, in Provence, in the year 1823, and was long in coming to his own. His birthday, indeed, is now celebrated annually (Henri Fabre is still alive) at both Sérignan and Orange ; but, as Maurice Maeterlinck, writing of this "Insect's Homer . . . whose brow should be girt with a double and radiant crown," says :

"Fame is often forgetful, negligent, behindhand or unjust ; and the crowd is almost ignorant of the name of J. H. Fabre, who is one of the most profound and inventive scholars and also one of the purest writers and, I was going to add, one of the finest poets of the century that is just past."

Fabre's *Souvenirs Entomologiques* form ten volumes, containing two to three hundred essays in all. The present book is a translation of the greater part of a volume of selected essays, comprising, in addition to those here presented, three that appeared in a volume entitled *Insect Life* and published ten years ago by Messrs. Macmillan, in a version from the able pen of



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the author of *Mademoiselle Mori*. This volume contained also the first of the four articles descriptive of the habits of the Sacred Beetle ; and the publishers desire me to express their thanks to Messrs. Macmillan for permission to include in *The Life and Love of the Insect* a variant of that first chapter from *Insect Life*. The omission of three essays included in the French volume of selections explains the absence of reference to certain insects represented in some of the photographic plates.

I should like to mention my personal sense of gratitude to a gentleman belonging to a class of workers whose services are not always recognized in the manner which they deserve. I speak of Mr. Marmaduke Langdale, my untiring, eager and accurate " searcher," whose work at both branches of the British Museum—to say nothing of his uncommonly thorough acquaintance with the French language—has greatly assisted me in my task of translation and saved me, I suspect, from making more than one blunder.

ALEXANDER TEIXEIRA DE MATTOS.

CHELSEA, 11 *July*, 1911.

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# THE SACRED BEETLE

# THE LIFE AND LOVE OF THE INSECT

## CHAPTER I

### THE SACRED BEETLE

The building of the nest, the safeguard of the family, furnishes the loftiest expression of the instinctive faculties. That ingenious architect, the bird, teaches us as much; and the insect, with its still more varied talents, repeats the lesson, telling us that maternity is the supreme inspirer of the instinct. Placed in charge of the duration of the species, which is of more serious interest than the preservation of individuals, maternity awakens a marvellous foresight in the drowsiest intelligence; it is the thrice sacred hearth wherein smoulder and then suddenly burst forth those incomprehensible psychic gleams which give us the impression of an infallible reasoning power. The more maternity asserts itself, the higher does instinct ascend.

The most worthy of our attention in this respect are the Hymenoptera, upon whom the cares of maternity devolve in their fulness. All these favourites of instinct prepare board and lodging for their offspring. They become past masters in a host of industries for the sake of a family which their faceted eyes never behold and

which, nevertheless, the maternal foresight knows quite well. One becomes a manufacturer of cotton goods and mills cotton-wool bottles ; another sets up as a basket-maker and weaves hampers out of scraps of flowers ; a third turns mason and builds rooms of cement and domes of road-metal ; a fourth starts a pottery-works, in which the clay is kneaded into shapely vases and jars and bulging pots ; yet another adopts the calling of a pitman and digs mysterious warm, moist passages underground. A thousand trades similar to ours and often even unknown to our industrial system are employed in the preparation of the abode. Next come the victuals of the expected nurslings : piles of honey, loaves of pollen, stores of preserved game, cunningly paralyzed. In such works as these, having the future of the family for their exclusive object, the highest manifestations of the instinct are displayed under the impulse of maternity.

In the rest of the entomological order, the mother's cares are generally very summary. In most cases, they are confined to the laying of the eggs in favourable spots, where the grub can find a bed and food at its own risk and peril. Where education is so rustic, talents are superfluous. Lycurgus banished the arts from his republic, as enervating. In like manner, the higher inspirations of the instinct are banished among insects brought up in Spartan simplicity. The mother neglects the gentle cares of the cradle ; and the prerogatives of the intellect, the best of all, diminish and disappear, so true is it that for the animal, even as for ourselves, the family is a source of perfection.

While the Hymenoptera, so extremely thoughtful of their progeny, fill us with wonder, the others, which abandon theirs to the chances of good luck or bad, must seem

to us, by comparison, of but little interest. These others form almost the entirety ; at least, to my knowledge, among the fauna of our country-sides, there is only one other instance of insects preparing board and lodging for their family, as do the gatherers of honey and the buriers of baskets full of game.

And, strange to say, those insects vying in maternal tenderness with the flower-despoiling tribe of Bees are none other than the Dung-beetles, the dealers in ordure, the scavengers of the meadows contaminated by the herd. We must pass from the scented corollas of the flower-bed to the droppings left on the high-road by the mule to find a second example of devoted mothers and lofty instincts. Nature abounds in these antitheses. What are our ugliness and beauty, our cleanliness and dirt to her ? With refuse, she creates the flower ; from a little manure, she extracts the blessed grain of the wheat.

Notwithstanding their filthy trade, the Dung-beetles occupy a very respectable rank. Thanks to their usually imposing size ; to their severe and irreproachably glossy garb ; to their short, stout, thickset shape ; to the quaint ornamentation either of their brow or, also, of their thorax, they cut an excellent figure in the collector's boxes, especially when to our own species, oftenest of an ebon black, we add a few tropical species flashing with gleams of gold and ruddy copper.

They are the sedulous guests of our herds, for which reason several of them emit a mild flavour of benzoic acid, the aromatic of the sheepfolds. Their pastoral habits have impressed the nomenclators, who, too often, alas, careless of euphony, have changed their note this time and headed their descriptions with such names as Melibæus, Tityrus, Amyntas, Corydon, Mopsus and Alexis.

We have here the whole series of bucolic denominations made famous by the poets of antiquity. Virgil's eclogues have lent their vocabulary for the Dung-beetles' glorification.

What alacrity around one and the same dropping! Never did adventurers hurrying from the four corners of the earth display such eagerness in working a Californian claim. Before the sun becomes too hot, they are there in their hundreds, large and small, promiscuously, of every sort, shape and size, hastening to carve themselves a slice of the common cake. There are some that work in the open air and scrape the surface; there are some that dig themselves galleries in the thick of the heap, in search of choice veins; others work the lower stratum and bury their spoil without delay in the underlying ground; others—the smallest—stand aside to crumble a morsel that has fallen from the mighty excavations of their more powerful fellow-workers. Some, the newcomers and, no doubt, the hungriest, consume their meal on the spot; but the greater number mean to put by a substance that will allow them to spend long days in plenty, down in some safe retreat. A nice, fresh dropping is not found just when you want it, amid the fields bare of thyme; a windfall of that sort is as manna from the sky; only fortune's favourites receive so fair a portion. Wherefore the riches of to-day are prudently stored for the morrow.

The stercoraceous scent has carried the glad tidings half a mile around; and all have hastened up to gather provisions. A few laggards are still arriving, a-wing or on foot.

Who is this that trots towards the heap, fearing lest he come too late? His long legs move with a sudden,

awkward action, as though driven by some mechanism within his belly; his little red antennæ spread their fan, a sign of anxious greed. He is coming, he has come, not without sending some few banqueters sprawling. It is the Sacred Beetle, clad all in black, the biggest and most famous of our Dung-beetles. Ancient Egypt held him in veneration and looked upon him as a symbol of immortality. Here he now sits at table, beside his fellow-guests, each of whom is giving the last touches to his ball with the flat of his broad fore-legs or else enriching it with yet one more layer before retiring to enjoy the fruit of his labours in peace. Let us follow the construction of the famous ball in all its phases.

The shield, that is to say, the broad, flat edge of the head, is notched with six angular teeth arranged in a semicircle. This constitutes the tool for digging and separating, the rake that lifts and casts aside the unnutritious vegetable fibres, goes for something better, scrapes and collects it together. A choice is thus made, for these dainty epicures differentiate between one thing and another: a casual choice, if the Beetle be interested in his own provender, but a most scrupulous choice, when it becomes a question of constructing the maternal ball.

For his own needs, the Beetle is less fastidious and contents himself with a wholesale selection. The notched shield scoops and digs, eliminates and gathers somewhat at random. The fore-legs play a mighty part in the work. They are flattened, curved into the segment of a circle, supplied with powerful nervures and armed on the outside with five sturdy teeth. If a powerful effort be needed to remove an obstacle or to force a way through the thickest part of the heap, the Dung-beetle makes

play with his elbows, that is to say, he flings his toothed legs to right and left and clears a semi-circular space with a vigorous thrust of the rake. Room once made, a different kind of work is found for these same limbs : they collect armfuls of the material raked together by the shield and push it under the insect's belly, between the four hind-legs. These are shaped for the turner's trade. The legs, especially the last two, are long and slender, slightly bowed and ending in a very sharp claw. One has but to look at them to recognize a pair of spherical compasses capable of embracing a globular body in their curved branches and improving its form. In fact, their mission is to shape the ball.

Armful by armful, the material is heaped up under the belly, between the four legs, which, by a slight pressure, impart their own curve to it and give it a first fashion. Then, betweenwhiles, the rough-hewn pill is set spinning betwixt the four branches of the two spherical compasses ; it turns under the Dung-beetle's belly until it is rolled into a perfect ball. Should the surface layer lack plasticity and threaten to peel off, should some too-stringy part refuse to yield to the action of the wheel, the fore-legs correct the faulty places ; their broad beaters pat the ball to give consistency to the new layer and to imbed the recalcitrant scraps into the mass.

Under a hot sun, when the work is urgent, one stands amazed at the turner's feverish activity. And thus the business proceeds apace : what was but lately a scanty pellet is now a ball the size of a walnut ; soon it will be a ball the size of an apple. I have seen greedy-guts manufacture a ball the size of one's fist. Here, of a certainty, is food in the larder for days to come !

The provisions are made. The next thing is to withdraw

from the fray and carry the victuals to a fitting place. Here the most striking characteristics of the Scarab begin to show themselves. The Dung-beetle sets out without delay ; he embraces the sphere with his two long hind-legs, whose terminal claws, planted in the mass, serve as rotatory pivots ; he obtains a purchase with the middle pair of legs ; and, using the armlets of his fore-legs for leverage, he travels backwards with his load, bending his body, with his head down and his hinder part in the air. The hind-legs, the principal factor in the machinery, move continually, coming and going, shifting the claws to change the axis of rotation, maintain the equilibrium of the load and push it on by alternate thrusts to right and left. In this way, the ball finds itself touching the ground by turns with every point of its surface, a process which perfects its shape and gives an even consistency to its outer layer by means of pressure uniformly divided.

And now, cheerily ! It moves, it rolls ; we shall get there, though not without accident. Here is a first difficult step : the Beetle is wending his way athwart a slope and the heavy mass tends to follow the incline ; but the insect, for reasons best known to itself, prefers to cut across this natural road, a bold plan which a false step or a grain of sand disturbing the balance may defeat. The false step is made ; the ball rolls to the bottom of the valley ; and the insect, toppled over by the impetus of its load, kicks about, gets up on its legs again and hastens to harness itself once more. The mechanism is working better than ever. But look out, you scatter-brain ! Follow the dip of the valley : that will save you labour and mishap ; the road is good and level ; your ball will roll quite easily. Not a bit of it ! The insect prepares once more to mount the slope that was already

its undoing. Perhaps it suits it to return to the heights. Against that I have nothing to say : the Scarab's opinion is more far-seeing than mine as to the advisability of keeping to lofty regions. But, at least, take this path, which will lead you up by a gentle incline ! Not at all ! If he find himself near some very steep slope, impossible to climb, that is what the obstinate fellow prefers. And now begins a labour of Sisyphus. The ball, that enormous burden, is painfully hoisted, step by step, with infinite precautions, to a certain height, always backwards. I ask myself by what static miracle so great a mass can be kept upon the slope. Oh ! An ill-planned movement frustrates all this toil : the ball comes down, dragging the beetle with it ! The escalade is repeated, soon to be followed by another fall. The attempt is renewed, better-managed this time at the difficult points ; a confounded grass-root, the cause of the previous tumbles, is carefully turned. We are almost there ; but gently, gently ! The ascent is dangerous and a mere nothing may yet spoil all. For see, a leg slips on a smooth bit of gravel ! Down come ball and Dung-beetle, all mixed up together. And the Beetle begins over again, with indefatigable persistency. Ten times, a score of times, he will attempt the thankless ascent, until his obstinacy vanquishes all obstacles, or until, recognizing the uselessness of his efforts, he takes to the level road.

The Scarab does not always push his precious ball alone : sometimes he takes a partner ; or, to be accurate, the partner takes him. This is how the thing usually happens : once his ball is ready, a Dung-beetle issues from the crowd and leaves the work-yard, pushing his spoil behind him. A neighbour, one of the newcomers, whose own task is hardly begun, suddenly drops his work and

runs to the ball now rolling, to lend a hand to the lucky owner, who seems to accept the proffered aid kindly. Henceforth, the two cronies work as partners. Each does his best to push the pellet to a place of safety. Was a compact really concluded in the work-yard, a tacit agreement to share the cake between them? While one was kneading and moulding the ball, was the other tapping rich veins whence to extract choice materials and add them to the common store? I have never observed such a collaboration; I have always seen each Dung-beetle occupied solely with his own affairs in the works. The last-comer, therefore, has no acquired rights.

Is it, then, a partnership between the two sexes, a couple intending to set up house? I thought so for a time. The two beetles, one before, one behind, pushing the heavy ball with equal zeal, reminded me of a song which the barrel-organs used to grind out some years ago:

> Pour monter notre menage, hélas! comment feront-nous?
> Toi devant et moi derrière, nous pousserons le tonneau.[1]

The evidence of the scalpel compelled me to abandon this domestic idyll. There is no outward difference between the two sexes in the Dung-beetle. I, therefore, dissected the two beetles engaged in conveying one and the same ball; and they often proved to belong to the same sex.

Neither community of family nor community of toil! Then what is the motive for this apparent partnership? It is just simply an attempt at robbery. The eager fellow-worker, under the deceitful pretence of lending a helpful hand, nurses the scheme of purloining the ball at

[1] "When you and I start housekeeping, alas, what shall we do?
You in front and I behind, we'll shove the tub along!"

the first opportunity. To make one's own ball at the heap implies drudgery and patience ; to steal one ready-made, or at least to foist one's self as a guest, is a much easier matter. Should the owner's vigilance slacken, you can run away with the treasure ; should you be too closely watched, you can sit down to table uninvited, pleading services rendered. It is, " Heads I win, tails you lose," in these tactics, so that pillage is exercised as one of the most lucrative of trades. Some go to work craftily, in the way I have just described : they come to the aid of a comrade who has not the least need of them and hide a most indelicate greed under the cloak of charitable assistance. Others, bolder perhaps, more confident in their strength, go straight to the goal and commit robbery with violence.

Scenes are constantly happening such as this : a Scarab walks off, peacefully and alone, rolling his ball, his lawful property, acquired by conscientious work. Another comes flying up, I know not whence, drops down heavily, folds his smoky wings under their elytra and, with the back of his toothed armlets, knocks over the owner, who is powerless to ward off the attack in his harnessed posture. While the dispossessed one struggles to his feet, the other perches himself atop the ball, the best position from which to repel the assailant. With his armlets folded under his breast, ready at all points, he awaits events. The victim of the theft moves round the ball, seeking a favourable spot at which to attempt the assault ; the thief spins round on the roof of the citadel, constantly facing him. If the first raise himself in order to scale the wall, the second gives him a cuff that stretches him on his back. Safe at the top of his fortress, the besieged Beetle would baffle his adversary's attempts indefinitely,

if the latter did not change his tactics to recover his property. Sapping is brought into play to bring down the citadel with the garrison. The ball, shaken from below, staggers and rolls, carrying with it the robber, who makes violent efforts to maintain his position on the top. This he succeeds in doing, though not always, thanks to hurried feats of gymnastics that enable him to regain a level from which the rolling of his support tends to drive him. Should a false movement bring him to the ground, the chances become equal and the struggle turns into a wrestling-match. Robber and robbed grapple at close quarters, breast to breast. Their legs twist and untwist, their joints intertwine, their horny armour clashes and grinds with the rasping sound of filed metal. Then that one of the two who succeeds in throwing his adversary and releasing himself hurriedly takes up a position on the top of the ball. The siege is renewed, now by the robber, now by the robbed, as the chances of the hand-to-hand conflict may have determined. The former, no doubt a hardy filibuster and adventurer, often has the best of the fight. Then, after two or three defeats, the ejected Beetle wearies and returns philosophically to the heap, there to make himself a new pellet. As for the other, with all fear of a surprise at an end, he harnesses himself to the conquered ball and pushes it whither he pleases. I have sometimes seen a third thief appear upon the scene and rob the robber. Nor can I honestly say that I was sorry.

I ask myself in vain what Proudhon[1] introduced into Beetle-morality the daring paradox that "property is based on plunder," or what diplomatist taught Dung-beetles the savage maxim that "might is right." I have

[1] Jean Baptiste Victor Proudhon (1758-1838), author of *De la distinction des biens, Traité du domaine public*, etc.—*Translator's Note.*

no facts whereby to trace the origin of these spoliations which have become a custom, of this abuse of strength to capture a lump of ordure. All that I can say is that theft is in general use among the Scarab tribe. These Dung-rollers rob one another among themselves with a calm effrontery of which I know no other instance. I leave it to future observers to elucidate this curious problem in animal psychology and I return to the two partners rolling their ball in concert.

Let us call the two fellow-workers partners, although that is not the proper name for them, seeing that the one forces himself upon the other, who probably accepts outside help only for fear of a worse evil. The meeting, however, is absolutely peaceful. The Beetle owning the ball does not cease work for an instant at the arrival of his assistant ; and the newcomer seems animated by the best intentions and sets to work on the spot. The way in which the two partners harness themselves differs. The owner occupies the chief position, the place of honour : he pushes behind the load, with his hind-legs in the air and his head down. The assistant is in front, in the reverse position, head up, toothed arms on the ball, long hind-legs on the ground. Between the two, the ball rolls along, pushed before him by the first, dragged towards him by the second.

The efforts of the couple are not always very harmonious, the more so as the helper has his back to the road to be traversed, while the owner's view is impeded by the load. Hence arise constant accidents, absurd tumbles, taken cheerfully and in good part : each picks himself up quickly and resumes the same position as before. On level ground, this system of draught does not correspond with the dynamic force expended, for

lack of precision in the combined movements : the Scarab at the back would do as well and better if left to himself. And so the helper, after giving a proof of his good-will at the risk of disturbing the mechanism, decides to keep still, without, of course, abandoning the precious ball, which he already looks upon as his : finding is keeping ; a ball touched is a ball gained. He will commit no such imprudence : the other might give him the slip !

He, therefore, gathers his legs under his belly, flattens himself, encrusts himself, so to speak, on the ball and becomes one with it. Henceforth, the whole concern—ball and Beetle clinging to its surface—rolls along, pushed by the lawful owner. Whether the load passes over his body, whether he occupies the top, the bottom or the side of the rolling burden matters little to the intruder, who sits tight and lies low. A singular helper this, who has himself driven in a carriage to secure his share of the victuals !

But a steep ascent heaves in sight and gives him a fine part to play. He now, on the stiff slope, takes the lead, holding the heavy mass with his toothed arms, while his mate seeks a purchase to hoist the load a little higher. Thus, by a combination of well-managed efforts, the one above gripping, the one below pushing, I have seen them together mount acclivities where the stubborn determination of one alone would have come to naught. But not all have the same zeal at these difficult moments : there are some who, on slopes where their assistance is most needed, seem not in the least aware of the difficulties to overcome. While the unhappy Sisyphus exhausts himself in endeavours to pass the dangerous place, the other quietly leaves him to do his best and, himself encrusted on the ball, rolls down with it, when it comes to grief, and is hoisted up with it anew.

Let us suppose the Scarab fortunate enough to have found a loyal partner ; or, better still, let us suppose that he has met no self-invited colleague. The burrow is ready. It is a cavity dug in soft earth, usually in sand, shallow, the size of one's fist and communicating with the outside by a short channel just large enough for the passage of the ball. As soon as the provisions are safely housed, the Scarab shuts himself in by stopping up the entrance to his dwelling with rubbish reserved for the purpose in a corner. Once the door is closed, no sign outside betrays the banqueting-hall. And, now, welcome mirth and jollity ! All is for the best in the best of all possible worlds ! The table is sumptuously laid ; the ceiling tempers the heat of the sun and allows but a mild, moist heat to penetrate ; the calm, the darkness, the concert of the crickets overhead all favour the digestive functions. So great has been my illusion that I have caught myself listening at the door, expecting to hear the revellers burst into that famous snatch from the opera of *Galatée :*[1]

> Ah ! qu'il est doux de ne rien faire
> Quand tout s'agite autour de nous.[2]

Who would dare disturb the bliss of such a banquet ? But the wish to learn is capable of all things ; and I had the courage. I will set down here the result of my violations of the sanctity of domestic life : the ball by itself fills almost the whole of the room ; the rich repast rises from floor to ceiling. A narrow passage runs between it and the walls. Here sit the banqueters, two at

[1] A light opera, with music by Victor Massé and libretto by Jules Barbier and Michel Carré (1852).—*Translator's Note.*

[2] "Ah, how sweet is far niente,
When round us throbs the busy world !"

most, very often but one, belly to table, back to the wall. Once the seat is chosen, no one stirs ; all the vital forces are absorbed by the digestive faculties. No little movements, which might cause the loss of a mouthful ; no dainty toying with the food, which might cause the waste of some. Everything has to pass, properly and in order. To see them so pensively seated around a ball of dung, one would think that they were aware of their task as scavengers of the earth and that they consciously devoted themselves to that marvellous chemistry which out of filth brings forth the flower, the joy of our eyes, and the Beetles' elytra, the ornament of our lawns in spring. For the purpose of this transcendental work, which is to turn into live matter the residue discarded by the horse and the mule, despite the perfection of their digestive organs, the Dung-beetle must needs be specially equipped. And, in point of fact, anatomy compels us to admire the prodigious length of his intestine, which, folded and refolded upon itself, slowly elaborates the materials in its profuse circuits and exhausts them to the very last serviceable atom. From that whence the stomach of the herbivorous animal has been able to extract nothing, this powerful alembic wrings riches that, at a mere touch, turn into ebon armour in the Sacred Scarab and a breastplate of gold and rubies in other Dung-beetles.

Now this wonderful metamorphosis of ordure has to be accomplished in the shortest possible time : the general health demands it. And so the Scarab is endowed with matchless digestive powers. Once housed in the company of food, day and night he will not cease eating and digesting until the provisions be exhausted. It is easy, with a little practice, to bring up the Scarab in captivity, in a volery. In this way, I obtained the following evi-

dence, which will tell us of the high digestive capacity of the famous Dung-beetle.

When the whole ball has been through the mill, the hermit reappears in the light of day, seeks his fortune, finds it, shapes himself a new ball and begins all over again. On a very hot, calm, sultry day—the atmospheric conditions most favourable to the gastronomic enjoyments of my anchorites—watch in hand, I observe one of the consumers in the open air, from eight o'clock in the morning until eight o'clock at night. The Scarab appears to have come across a morsel greatly to his taste, for, during those twelve hours, he never stops feasting, remains permanently at table, stationary at one spot. At eight o'clock in the evening, I pay him a last visit. His appetite seems undiminished. I find the glutton in as fine fettle as at the start. The banquet, therefore, must have lasted some time longer, until the total disappearance of the lump. Next morning, in fact, the Scarab is gone and, of the fine piece attacked on the previous day, naught remains but crumbs.

Once round the clock and more, for a single sitting at table, is a fine display of gormandizing in itself ; but here is something much better by way of rapidity of digestion. While, in front of the insect, the matter is being continuously chewed and swallowed, behind it, with equal continuity, the matter reappears, stripped of its nutritive particles and spun into a little black cord, similar to a cobbler's thread. The Scarab never evacuates except at table, so quickly are his digestive labours performed. The apparatus begins to work at the first few mouthfuls ; it ceases its office soon after the last. Without a break from beginning to end of the meal and always hanging to the discharging orifice, the thin cord is piled in a

heap which is easy to unroll so long as it is not dried up.

The thing works with the regularity of a chronometer. Every minute, or, rather, to be accurate, every four-and-fifty seconds, an eruption takes place and the thread is lengthened by three to four millimetres.[1] At long intervals, I employ the pincers, unfasten the cord and unroll the heap along a graduated rule, to estimate the produce. The total measurement for twelve hours is 2·88 metres.[2] As the meal and its necessary complement, the work of the digestive apparatus, went on for some time longer after my last visit, paid at eight o'clock in the evening by the light of a lantern, it follows that my subject must have spun an unbroken stercoraceous cord well over three yards in length.

Given the diameter and the length of the thread, it is easy to calculate its volume. Nor is it difficult to arrive at the exact volume of the insect by measuring the amount of water which it displaces when immersed in a narrow cylinder. The figures thus obtained are not uninteresting : they tell us that, at a single festive sitting, in a dozen hours, the Scarab digests very nearly its own volume in food. What a stomach ! And especially what a rapidity, what a power of digestion ! From the first mouthfuls, the residuum forms itself into a thread that stretches, stretches out indefinitely as long as the meal lasts. In that amazing laboratory, which perhaps never puts up its shutters, unless it be when victuals are lacking, the material only passes through, is worked upon at once by the reagents in the stomach and at once exhausted. We may well believe that a crucible so quick to purify dirt plays its part in the general hygiene.

[1] ·11 to ·15 inches.—*Translator's Note.*

[2] Close upon 9½ feet.—*Translator's Note.*

## CHAPTER II

### THE SACRED BEETLE : THE PEAR

A YOUNG shepherd, who had been told in his spare time to watch the doings of the Sacred Beetle, came to me in high spirits, one Sunday, in the second half of June, to say that he thought the time had come to commence a search. He had detected the insect issuing from the ground, had dug at the spot where it made its appearance and had found, at no great depth, the queer thing which he was bringing me.

Queer it was and calculated to upset the little which I thought I knew. In shape, it was exactly like a tiny pear that had lost all the colour of its freshness and turned brown in rotting. What could this curious object be, this pretty plaything that seemed to come from a turner's workshop ? Was it made by human hands ? Was it a model of the fruit of the pear-tree intended for some child's collection ? One would say so.

The children come round me ; they look at the treasure-trove with longing eyes ; they would like to add it to the contents of their toy-box. It is much prettier in shape than an agate marble, much more graceful than an ivory egg or a box-wood top. The material, it is true, seems none too nicely chosen ; but it is firm to the touch and very artistically curved. In any case, the little pear discovered underground must not go to swell the collection of nursery treasures until we have found out more about it.

Can it really be the Scarab's work ? Is there an egg inside it, a grub ? The shepherd assures me that there is. A similar pear, crushed by accident in the digging, contained, he says, a white egg, the size of a grain of wheat. I dare not believe it, so greatly does the object which he has brought me differ from the ball which I expected to see.

To open the puzzling " find " and ascertain its contents would perhaps be imprudent : such an act of violence might jeopardize the life of the germ enclosed, always provided that the Scarab's egg be there, a matter of which the shepherd seems convinced. And then, I imagine, the pear-shape, opposed to every accepted idea, is probably accidental. Who knows if chance has anything like it in store for me in the future ? It were wise to keep the thing as it is, to await events ; above all, it were wise to go in search of information on the spot.

The shepherd was at his post by daybreak the next morning. I joined him on some slopes that had been lately cleared of their trees, where the hot summer sun, which strikes so powerfully on the neck, could not reach us for two or three hours. In the cool air of morning, with the flock browsing under the care of the sheep-dog, we went in search together.

Scarabæus' burrow is soon found : it is recognizable by the recent mole-hill that surmounts it. My companion digs with a vigorous wrist. I have lent him my little pocket-trowel, the light, but workmanlike tool which, incorrigible earth-scraper that I am, I seldom omit to take with me when I go out. I lie down, the better to see the arrangement and furnishing of the hypogeum in process of excavation ; and I am all eyes. The

shepherd uses the trowel as a lever and, with his free hand, pushes back the rubbish.

Here we are! A cave opens out and, in the moist warmth of the yawning vault, I see a splendid pear lying full-length upon the ground. I shall certainly long remember this first revelation of the maternal work of the Scarab. My excitement could have been no greater were I an archæologist digging among the ancient relics of Egypt and lighting upon the sacred insect of the dead, carved in emerald, in some Pharaonic crypt. O blessed joys of truth suddenly shining forth, what others are there to compare with you! The shepherd was in the seventh heaven: he laughed in response to my smile and was happy in my gladness.

Luck does not repeat itself: "*Non bis in idem*," says the old adage. And here have I twice had under my eyes this curious shape of the pear. Could it be the normal shape, not subject to exception? Must we abandon all thought of a sphere similar to those which the insect rolls on the ground? Let us continue and we shall see. A second hole is found. Like the previous one, it contains a pear. The two discoveries are as like as two peas; they might have issued from the same mould. And a valuable detail is this: in the second burrow, beside the pear and lovingly embracing it, is the mother Beetle, engaged, no doubt, in giving it the finishing touches before leaving the underground cave for good. All doubts are dispelled: I know the worker and I know the work.

The rest of the morning confirmed these premisses to the full: before an intolerable sun drove me from the slope explored, I possessed a dozen pears identical in shape and almost in dimensions. On various occasions, the mother was present in the workshop.

Burrow and pear-shaped ball of the Sacred Beetle.

PLATE II

Let me tell, to finish with this part of our subject, what the future held in store for me. During the whole of the dog-days, from the end of June until September, I renewed almost daily my visits to the spots frequented by the Scarab ; and the burrows dug up with my trowel supplied me with an amount of evidence exceeding my fondest hopes. The insects brought up in the volery supplied me with further documents, though these, it is true, were rare and not to be compared with the riches of the open fields. All told, at least some hundred nests passed through my hands ; and it was always the graceful shape of the pear, never, absolutely never, the round shape of the pill, never the ball of which the books tell us.

And now let us unfold the authentic story, calling to witness none save facts actually observed and reobserved. The Sacred Beetle's nest is betrayed on the outside by a heap of shifted earth, by a little mole-hill formed of the superfluous rubbish which the mother, when closing up the abode, has been unable to replace, as a part of the excavation must be left empty. Under this heap is a shallow pit, about two-fifths of an inch deep, followed by a horizontal gallery, either straight or winding, which ends in a large hall, spacious enough to hold a man's fist. This is the crypt in which the egg lies wrapped in food and subjected to the incubation of a burning sun, at a few inches underground ; this is the roomy workshop in which the mother, enjoying full liberty of movement, has kneaded and shaped the future nursling's bread into a pear.

This stercoral bread has its main axis lying in a horizontal position. Its shape and size remind one exactly of those little *poires de Saint-Jean* which, thanks to their bright colouring, their flavour and their early ripeness,

delight the children's tribe. The bulk varies within narrow limits. The largest dimensions are 45 millimetres in length by 30 millimetres in width ;[1] the smallest are 35 millimetres by 28.[2]

Without being as polished as stucco, the surface, which is absolutely regular, is carefully smoothed under a thin layer of red earth. At first, when of recent construction, soft as potter's clay, the pyriform loaf soon, in the course of desiccation, acquires a stout crust that refuses to yield under the pressure of fingers. Wood itself is no harder. This bark is the defensive wrapper which isolates the recluse from this world and allows him to consume his victuals in profound peace. But, should desiccation reach the central mass, then the danger becomes extremely serious. We shall have occasion to return to the woes of the grub exposed to a diet of too-stale bread.

What dough does the Scarab's bake-house use ? Who are the purveyors ? The mule and the horse ? By no means. And yet I expected to find it so—and so would everybody—at seeing the insect draw so eagerly, for its own use, upon the plentiful garner of an ordinary lump of dung. For that is where it habitually manufactures the rolling ball which it goes and consumes in some underground retreat.

Whereas coarse bread, crammed with bits of hay, is good enough for the mother, she becomes more dainty where her family are concerned. She now wants fine pastry, rich in nourishment and easily digested ; she now wants the ovine manna : not that which the sheep of a dry habit scatters in trails of black olives, but that which,

[1] 1·8 × 1·4 inches.—*Translator's Note.*
[2] 1·4 × 1·1 inches.—*Translator's Note.*

elaborated in a less parched intestine, is kneaded into biscuits all of a piece. That is the material required, the dough exclusively used. It is no longer the poor and stringy produce of the horse, but an unctuous, plastic, homogeneous thing, soaked through and through with nourishing juices. Its plasticity, its delicacy are admirably adapted to the artistic work of the pear, while its alimentary qualities suit the weak stomach of the newborn progeny. Little though the bulk be, the grub will here find sufficient food.

This explains the smallness of the alimentary pears, a smallness that made me doubt the origin of my find, before I came upon the mother in the presence of the provisions. I was unable to see in those little pears the bill of fare of a future Sacred Beetle, himself so great a glutton and of so remarkable a size.

Where is the egg in that nutritive mass so novel in shape ? One would be inclined to place it in the centre of the fat, round paunch. This central point is best-protected against accidents from the outside, best-endowed with an even temperature. Besides, the budding grub would here find a deep layer of food on every side of it and would not be exposed to the mistakes of the first few mouthfuls. Everything being alike on every side of it, it would not be called upon to choose ; wherever it chanced to apply its novice tooth, it could continue without hesitation its first dainty repast.

All this seemed so very reasonable that I allowed myself to be led away by it. In the first pear which I explored, slender layer by slender layer, with the blade of a penknife, I looked for the egg in the centre of the paunch, feeling almost certain of finding it there. To my great surprise, it was not there. Instead of being hollow, the

centre of the pear is full and consists of one continuous, homogeneous alimentary mass.

My deductions, which any observer in my place would certainly have shared, seemed very reasonable; the Scarab, however, is of another way of thinking. We have our logic, of which we are rather proud; the Dung-kneader has hers, which is better than ours in this contingency. She has her own foresight, her own discernment of things; and she places her egg elsewhere.

Fig. 1.—Section of the Sacred Beetle's pill, showing the egg and the hatching-chamber.

But where? Why, in the narrow part of the pear, in the neck, right at the end. Let us cut this neck lengthwise, taking the necessary precautions, so as not to damage the contents. It is hollowed into a recess with polished and shiny walls. This is the tabernacle of the germ, the hatching-chamber. The egg, which is very large in proportion to the size of the layer, is a long white oval, about 10 millimetres in length by 5 millimetres in its greatest width.[1] A slight empty space separates it on all sides from the chamber-walls. There is no contact with these walls, save at the rear end, which adheres to the top of the recess. Lying horizontally, following the normal position of the pear, the whole of it, excepting the point of attachment, rests upon an air-mattress, most elastic and warmest of beds. Let

[1] ·4 × ·2 inches.—*Translator's Note.*

us observe also that the top of the nipple, instead of being smooth and compact like the rest of the pear, is formed of a felt of particles of scrapings, which allows the air sufficient access for the breathing-needs of the egg.

We are now informed. Let us next try to understand the Scarab's logic. Let us account for the necessity for the pear, that form so strange in entomological industry; let us seek to explain the convenience of the curious situation of the egg. It is dangerous, I know, to venture upon the how and wherefore of things. We easily sink in this mysterious domain where the moving soil gives way beneath the feet, swallowing the foolhardy in the quicksands of error. Must we abandon such excursions, because of the risk? Why should we?

What does our science, so sublime compared with the frailty of our means, so contemptible in the face of the boundless spaces of the unknown, what does our science know of absolute reality? Nothing. The world interests us only because of the ideas which we form of it. Remove the idea and everything becomes sterile, chaos, empty nothingness. An omnium-gatherum of facts is not knowledge, but at most a cold catalogue which we must thaw and quicken at the fire of the mind; we must introduce thought and the light of reason; we must interpret.

Let us adopt this course to explain the work of the Sacred Beetle. Perhaps we shall end by attributing our own logic to the insect. After all, it will be just as remarkable to see a wonderful agreement prevail between that which reason dictates to us and that which instinct dictates to the animal.

A grave danger threatens the Sacred Beetle in its grub state: the drying-up of the food. The crypt in which

the larval life is spent has a layer of earth, some third of an inch thick, for a ceiling. Of what avail is this slender screen against the canicular heat that burns the soil, baking it like a brick to a far greater depth ? The grub's abode at such times acquires a scorching temperature ; when I thrust my hand into it, I feel the moist heat of a Turkish bath.

The provisions, therefore, even though they have to last but three or four weeks, are exposed to the risk of drying up before that time and becoming uneatable. When, instead of the tender bread of the start, the unhappy worm finds no food for its teeth but a repulsive crust, hard as a pebble and unassailable, it is bound to perish of hunger. And it does, in fact, so perish. I have found numbers of these victims of the August sun who, after eating plentifully of the fresh victuals and digging themselves a cell, had succumbed, unable to continue biting into fare too hard for their teeth. There remained a thick shell, a sort of closed oven, in which the poor wight lay baked and shrivelled up.

While the worm dies of hunger in the shell turned to stone by desiccation, the full-grown insect that has finished its transformations dies there too, for it is incapable of bursting the enclosure and freeing itself. I shall return later to the final delivery and will linger no more on this point. Let us occupy ourselves solely with the woes of the worm.

The drying-up of the victuals is, we say, fatal to it. This is proved by the grubs found baked in their oven ; it is also proved, in a more precise fashion, by the following experiment. In July, the period of active nidification, I place in wooden or cardboard boxes a dozen pears dug up, that morning, from the native spot. These

boxes, carefully closed, are put away in the dark, in my study, where the same temperature reigns as outside. Well, in none of them is the infant reared : sometimes the egg shrivels ; sometimes the worm is hatched, but very soon dies. On the other hand, in tin boxes or glass receptacles, things go very well : not one attempt at rearing fails.

Whence do these differences arise ? Simply from this : in the high temperature of July, evaporation proceeds apace under the pervious wooden or cardboard screen ; the alimentary pear dries up and the poor worm dies of hunger. In the impermeable tin boxes, in the carefully-sealed glass receptacles, evaporation does not take place, the provisions retain their softness and the grubs thrive as well as in their native burrow.

The insect employs two methods to ward off the danger of desiccation. In the first place, it compresses the outer layer with all the strength of its wide armlets, turning it into a protecting rind more homogeneous and more compact than the central mass. If I smash one of these well-dried boxes of preserves, the rind usually breaks off sharp and leaves the kernel in the middle bare. The whole suggests the shell and the almond of a filbert. The pressure exercised by the mother when manipulating her pear has influenced the surface layer to a depth of a few millimetres and from this results the rind ; further down, the pressure has not spread, whence proceeds the central kernel. In the hot summer months, my housekeeper puts her bread into a closed pan, to keep it fresh. This is what the insect does, in its fashion : by dint of compression, it confines the bread of the family in a pan.

The Sacred Beetle goes further still : she becomes a geometrician capable of solving a fine problem of mini-

mum values. All other conditions remaining equal, the evaporation is obviously in proportion to the extent of the evaporating surface. The alimentary mass must therefore be given the smallest possible surface, in order by so much to decrease the waste of moisture ; nevertheless, this smallest surface must unite the largest aggregate of nutritive materials, so that the worm may find sufficient nourishment. Now which is the form that encloses the greatest bulk within the smallest superficial area ? Geometry answers, the sphere.

The Scarab, therefore, shapes the worm's allowance into a sphere (we will pass over the neck of the pear for the moment) ; and this round form is not the result of blind mechanical conditions, imposing an inevitable shape upon the workman ; it is not the forcible effect of a rolling along the ground. We have already seen that, with the object of easier and swifter transit, the insect kneads the plunder which it intends to consume at a distance into an exact ball, without moving it from the spot at which it lies ; in a word, we have observed that the round form precedes the rolling.

In the same way, it will be shown presently that the pear destined for the worm is fashioned down in the burrow. It undergoes no process of rolling, it is not even moved. The Scarab gives it the requisite outline exactly as a modelling artist would do, shaping his clay under the pressure of the thumb.

Supplied with the tools which it possesses, the insect would be capable of obtaining other forms of a less dainty curve than its pear-shaped work. It could, for instance, make the coarse cylinder, the sausage in use among the Geotrupes ; simplifying the work to the utmost, it could leave the morsel without any settled form, just as it

happened to find it. Things would proceed all the faster and would leave more time for playing in the sun. But no : the Scarab adopts exclusively the sphere, so difficult in its precision ; she acts as though she knew the laws of evaporation and geometry from A to Z.

It remains for us to examine the neck of the pear. What can be its object, its use ? The reply forces itself upon us irresistibly. This neck contains the egg, in the hatching-chamber. Now every germ, whether of plant or animal, needs air, the primary stimulus of life. To admit that vivifying combustible, the air, the shell of a bird's egg is riddled with an endless number of pores. The pear of the Sacred Beetle may be compared with the egg of the hen. Its shell is the rind, hardened by pressure, with a view to avoiding untimely desiccation ; its nutritive mass, its meat, its yolk is the soft ball sheltered under the rind ; its air-chamber is the terminal space, the cavity in the neck, where the air envelopes the germ on every side. Where would that germ be better off, for breathing, than in its hatching-chamber projecting into the atmosphere and giving free play to the interchange of gases through its thin and easily penetrable wall and especially through the felt of scrapings that finishes the nipple ?

In the centre of the mass, on the other hand, aeration is not so easy. The hardened rind does not possess the eggshell's pores ; and the central kernel is formed of compact matter. The air enters it, nevertheless, for presently the worm will be able to live in it, the worm, a robust organism less difficult and nice than the first throbs of life.

These conditions, air and warmth, are so fundamental that no Dung-beetle neglects them. The nutritive hoards

vary in form, as we shall have occasion to perceive: in addition to the pear, such shapes as the cylinder, the ovoid, the pill and the thimble are adopted, according to the species of the manipulator; but, amid this diversity of outline, one feature of the first importance remains constant, which is the egg lodged in a hatching-chamber close to the surface, providing an excellent means for the easy access of air and warmth. And the most gifted in this delicate art is the Sacred Beetle with her pear.

I was urging just now that this first of Dung-kneaders behaved with a logic that rivals our own. At the point to which we have come, the proof of my statement is established. Nay, better still. Let us submit the following problem to our leading scientific lights: a germ is accompanied by a mass of victuals liable soon to be rendered useless by desiccation. How should the alimentary mass be shaped? Where should the egg be laid so as to be easily influenced by air and warmth?

The first question of the problem has already been answered. Knowing that evaporation is in proportion to the extent of the evaporating surface, science declares that the victuals shall be arranged in a ball, because the spherical form is that which encloses the greatest amount of material within the smallest surface. As for the egg, since it requires a protecting sheath to avoid any harmful contact, it shall be contained within a thin, cylindrical case; and this case shall be implanted on the sphere.

Thus the requisite conditions are fulfilled: the provisions, gathered into a ball, keep fresh; the egg, protected by its slender, cylindrical sheath, receives the influence of air and warmth without impediment. The

strictly needful has been obtained ; but it is very ugly. The practical has not troubled about the beautiful.

An artist corrects the brute work of reason. He replaces the cylinder by a semi-ellipsoid, of a much prettier form ; he joins this ellipsoid to the sphere by means of a graceful curved surface ; and the whole becomes the pear, the necked gourd. It is now a work of art, a thing of beauty.

The Scarab does exactly what the laws of æsthetics dictate to ourselves. Can she, too, have a sense of beauty ? Is she able to appreciate the elegance of her pear ? Certainly, she does not see it : she manipulates it in profound darkness. But she touches it. A poor touch hers, rudely clad in horn, yet not insensible, after all, to nicely-drawn outlines !

## CHAPTER III

### THE SACRED BEETLE : THE MODELLING

How does the Scarab obtain the maternal pear ? It is certain, to begin with, that this is in no wise shaped by the mechanism of conveyance along the ground : the shape is incompatible with a rolling in every direction, at haphazard. We might accept that for the belly of the gourd ; but the neck, the ellipsoid nipple, hollowed into a hatching-chamber ! This delicate work could never result from violent, unmeasured jerks. The goldsmith's jewel is not hammered on the blacksmith's anvil. Together with other reasons, all good in evidence, already quoted, the pear-shaped outline delivers us, I hope, once and for all, from the antiquated belief that placed the egg inside a roughly-jolted ball.

To produce his masterpiece, the sculptor retires to his den. Even so the Sacred Beetle. She shuts herself down in her crypt, to model, in contemplative seclusion, the materials introduced. Two opportunities offer for obtaining the block to be worked. In the one case, the Scarab gathers from the heap, according to the method which we know, a choice block, which is kneaded into a ball on the spot and which is already spherical before it is set in motion. Were it only a question of provisions intended for her own meals, she would never act otherwise.

When she thinks the ball of sufficient bulk, if the place do not suit her wherein to dig the burrow, she sets out with her rolling burden, walking at random till she lights upon a favourable spot. During the journey, the ball, without improving upon the perfect sphere which it was at the start, hardens a little on the surface and becomes encrusted with earth and little grains of sand. This earthy rind, picked up on the road, is an authentic sign of a more or less long excursion. The detail is not without importance ; it will serve us presently.

Less frequently, the spot close to the heap whence the block has been extracted satisfies the insect as suitable for the excavation of the burrow. The soil is free from pebbles and easy to dig. Here, no journey is necessary, nor, therefore, any ball convenient for transit. The soft biscuit of the sheep is gathered and stored as found and enters the workshop a shapeless mass, either in one piece, or, if need be, in different lumps.

This case occurs seldom in the natural state, because of the coarseness of the ground, which abounds with broken stones. Sites practicable for easy digging are few and far between and the insect has to roam about, with its burden, to find them. In my voleries, on the other hand, where the earthy layer has been purged with the sieve, it is the usual case. Here the earth is easy to dig at any point ; wherefore the mother, working for her laying, is content to lower the nearest morsel underground, without giving it any definite shape.

Whether the storing without preliminary ball or conveyance be achieved in the fields or in my voleries, the final result is most striking. One day, I see a shapeless lump disappear into the crypt. The next day, or the day after, I visit the workshop and find the artist face

to face with her work. The uncouth mass of the start, the loose shreds introduced by armfuls have become a pear of perfect accuracy and conscientious finish.

The artistic object bears the marks of its method of manufacture. The part that rests upon the bottom of the cavity is crusted over with earthy particles; all the rest is of a glossy polish. Owing to its weight, owing also to the pressure exercised when the Scarab manipulates it, the pear, which is still quite soft, has become soiled with grains of earth on the side that touches the floor of the workshop; on the remainder, which is the larger part, it retains the delicate finish which the insect was able to give it.

The inferences to be drawn from these minutely-observed details are obvious: the pear is no turner's work; it has not been obtained by any sort of rolling on the ground of the spacious studio, for then it would have been soiled with earth all over. Besides, its projecting neck precludes this mode of fabrication. It has not even been turned from one side to the other, as is loudly proclaimed by its unblemished upper surface. The Scarab, therefore, has moulded it where it lies, without turning or shifting it in any way; she has modelled it with little taps of her broad battledores, just as when we saw her model her ball in the daylight.

Let us now return to the usual case, in the open. The materials then come from a distance and are introduced into the burrow in the form of a ball covered with soil on every part of its surface. What will the insect do with this sphere which contains the paunch of the future pear ready-made? The answer would present no serious difficulty if, limiting my ambition to the results obtained, I sacrificed the means employed. It would be

enough for me, as I have often done, to capture the mother in her burrow with her ball and carry one and all home, to my animal laboratory, to watch events at first hand.

A large glass jar is filled with earth, sifted, moistened and heaped to the desired depth. I place the mother and her beloved pill, which she holds embraced, on the surface of this artificial soil. I stow away the apparatus in a half-light and wait. My patience is not very long tried. Urged by the labour of the ovaries, the insect resumes its interrupted work.

In certain cases, I see it, still on the surface, destroying its ball, ripping it up, cutting it to pieces, shredding it. This is not in the least the act of one in despair who, finding herself a captive, breaks the cherished object in her bewilderment. It is an act of wise hygienics. A scrupulous inspection of the morsel gathered in haste, among lawless competitors, is often necessary, for supervision is not always easy on the harvesting-spot itself, in the midst of thieves and robbers. The ball may contain a blend of little Onthophagi, of Aphodians, which have not been noticed in the heat of acquisition.

These involuntary intruders, finding themselves very comfortable in the heart of the mass, would themselves make good use of the contemplated pear, much to the detriment of the legitimate consumer. The ball must be purged of this starveling brood. The mother, therefore, destroys it, reduces it to atoms, scrutinizes it. Then, out of the collected remnants, the ball is remade, stripped of its earthy rind. It is dragged underground and becomes an immaculate pear, always excepting the surface touching the soil.

Oftener still, the ball is thrust by the mother into the

earth of the jar just as I took it from the burrow, with the wrinkled covering which it acquired in rolling across country during the journey from the place where it was found to the spot where the insect intended to use it. In that case, I find it at the bottom of my jar converted into a pear, itself wrinkled and encrusted with earth and sand over the whole of its surface, thus proving that the pear-shaped outline has not demanded a general re-casting of the mass, inside as well as out, but has been obtained by simple pressure and by drawing out the neck.

This is how, in the vast majority of cases, things happen in the normal state. Almost all the pears which I dig up in the fields are crusted, unpolished, some more, others less. If we put on one side the inevitable encrustations due to the carting across fields, these blemishes would seem to point to a prolonged rolling in the interior of the subterranean manor. The few which I find perfectly smooth, especially those wonderfully neat specimens furnished by my voleries, dispel this mistake entirely. They show us that, with materials collected near at hand and stored away unshaped, the pear is modelled wholly without rolling ; they prove to us that, where the others are concerned, the earthy wrinkles of the rind are not the signs of a rolling manipulation at the bottom of the workshop, but simply the marks of a fairly long journey on the surface of the ground.

To be present at the construction of the pear is no easy matter : the sombre artist obstinately refuses to do any work as soon as the light reaches her. She needs absolute darkness for her modelling ; and I need light if I would see her at work. It is impossible to unite the two conditions. Let us try, nevertheless ; let us seize by fragments the truth which hides itself in its fulness.

1. The Sacred Beetle pushing away and overturning a thieving friend who tries to force his assistance upon him.
2. Crypt in which the Beetle shapes a grub's provision into a pear.

The arrangements made are as follows : I once more take the large glass jar. I cover the bottom with a layer of earth a few inches in thickness. To obtain the transparent workshop necessary for my observations, I fix a tripod on the earthy layer and, on this support, a decimetre[1] high, I place a round deal slab of the same diameter as the jar. The glass-walled chamber thus marked out will represent the roomy crypt in which the insect works. In the edge of the deal slab, a hollow is cut, large enough to permit of the passage of the Sacred Beetle and her ball. Lastly, above this screen, I heap a layer of earth as deep as the jar allows.

During the operation, a portion of the upper earth falls through the opening and slips down to the lower space in a wide inclined plane. This was a circumstance which I had foreseen and which was indispensable to my plan. By means of this slope, the artist, when she has found the communicating trap-door, will make for the transparent den which I have arranged for her. She will make for it, of course, only provided that she be in perfect darkness. I therefore contrive a cardboard cylinder, closed at the top, and place the glass apparatus inside it. Left standing where it is, the opaque sheath will provide the dusk which the Scarab demands ; suddenly raised, it will give the light which I require on my side.

Things being thus arranged, I go in search of a mother lately removed from her natural lodging with her ball. A morning is enough to provide me with what I need. I place the mother and her ball on the surface of the upper layer of earth ; I cap the apparatus with its cardboard sheath ; and I wait. The insect, stubborn at

[1] 3·9 inches.—*Translator's Note.*

its work so long as the egg is not deposited, will dig itself a new burrow, dragging its ball with it as it goes ; it will pass through the upper layer of earth, which is not sufficiently thick ; it will come upon the deal board, an obstacle similar to the broken stones that often bar its passage in the course of its normal excavations ; it will investigate the cause of the impediment and, finding the opening, will descend through this trap-door to the lower compartment, which, being free and roomy, will represent to the insect the crypt whence I have just removed it. Thus prophesies my foresight. But all this takes time ; and I must wait for the morrow to satisfy my impatient curiosity.

The hour has come : let us go and see. The study-door was left open yesterday : the mere sound of the door-handle might stop my distrustful worker. By way of greater precaution, before entering, I put on silent slippers. And —— whoosh ! The cylinder is removed. Capital ! My expectations are fully justified.

The Scarab occupies the glazed workshop. I catch her at work, with her broad foot laid on the rough sketch of the pear. But, startled by the sudden light, she remains motionless, as though petrified. This lasts a few seconds. Then she turns her back upon me and awkwardly ascends the inclined plane, to reach the darkling heights of her gallery. I give a glance at the work, take note of its shape, its position and its aspect, and restore darkness with the cardboard sheath. Let us not prolong the indiscretion, if we would renew the test.

My sudden, brief visit gives us a first insight into the mysterious work. The ball, at first exactly spherical, now has a stout pad circumscribing a sort of shallow

crater. The work reminds me, in greatly reduced proportions, of certain prehistoric pots, with round bellies, thick lips around the mouth and a neck strangled by a narrow groove. This rude outline of a pear tells us of the insect's method, a method identical with that of Pleistoscene man ignorant of the potter's wheel.

The plastic ball, girt with a circle at one end, has been hollowed out in a groove, the starting-point of the neck ; it has, moreover, been drawn out a little into an obtuse projection. In the centre of this projection, a pressure has been effected, which, causing the matter to fall back over the edges, has produced the crater, with its shapeless lips. Circular enlacement and pressure have sufficed for this first part of the work.

FIG. 2. — The Sacred Beetle's pill dug out cupwise to receive the egg.

Towards evening, I pay a fresh sudden visit, amid complete silence. The insect has recovered from its excitement of the morning and gone down again to its workshop. Flooded with light and baffled by the strange events to which my artifices give rise, it at once makes off and takes refuge in the upper storey. The poor mother, persecuted by my illuminations, runs up into the thick of the darkness, but regretfully, with hesitating strides.

The work has progressed. The crater has become deeper ; the thick lips have disappeared, are thinner, closer together, drawn out into the neck of a pear. The object, however, has not changed its place. Its position, its aspect are exactly as I noted them before. The

side that lay on the ground is still at the bottom, at the same point ; the side that faced upwards is still at the top ; the crater that lay on my right has been replaced by the neck, still on my right. Whence comes a conclusion completely confirming my previous statements : no rolling ; mere pressure, which kneads and moulds.

The next day, a third visit. The pear is finished. Its neck, yesterday a yawning sack, is now closed. The egg, therefore, is laid ; the work has been carried through and demands only the finishing touches of general polishing, touches upon which the mother, so intent on geometrical perfection, was doubtless engaged at the time when I disturbed her.

The most delicate part of the affair escapes my observation. I see quite clearly, in the main, how the hatching-chamber of the egg is obtained : the thick pad surrounding the original crater is thinned and flattened out under the pressure of the feet and lengthened into a sack the mouth of which gradually narrows. Up to this point, the work provides its own explanation. But we have no explanation of the exquisite perfection of the cell wherein the egg is to hatch, when we think of the insect's rigid tools, the wide, toothed armlets whose jerky awkwardness suggests the spasmodic movements of an automaton.

With this clumsy equipment, excellently adapted to coarse work though it be, how does the Scarab obtain the natal dwelling, the oval nest so daintily polished and glazed within ? Does the foot, a regular saw, fitted with enormous teeth, begin to rival the painter's brush in delicacy from the moment when it is inserted through the narrow orifice of the sack ? Why not ? I have said elsewhere and this is the occasion to repeat it :

the tool does not make the workman. The insect exerts its gifts as a specialist with any kind of tool wherewith it is supplied. It can saw with a plane or plane with a saw, like the model workman of whom Franklin tells us. The same strong-toothed rake with which the Sacred Beetle rips the earth is used by her as a trowel and brush wherewith to glaze the stucco of the chamber in which the grub will be born.

In conclusion, one more detail concerning this hatching-chamber. At the extreme end of the neck of the pear, one point is always pretty clearly distinguished: it bristles with stringy fibres, while the rest of the neck is carefully polished. This is the plug with which the mother has closed the narrow opening after placing the egg; and this plug, as its hairy structure shows, has not been subjected to the pressure which, throughout the rest of the work, crams the smallest projecting scrap into the mass and causes it to disappear.

Why this arrangement at the extreme pole, a very curious exception, when every elsewhere the pear has received the powerful blows of the insect's foot? The hind-end of the egg rests against this plug, which, were it pressed down and driven in, would transmit the pressure to the germ and imperil its safety. The mother, aware of the risk, blocks up the hole without ramming the stopper: the air in the hatching-chamber is thus more easily renewed; and the egg escapes the dangerous concussion of the compressing paddle.

## CHAPTER IV

### THE SACRED BEETLE : THE GRUB, THE METAMORPHOSIS, THE HATCHING-CHAMBER

THE hatching-chamber is an oval recess about one centimetre[1] in diameter. The egg is fixed at the bottom of this recess. It is cylindrical in shape, rounded at both ends, yellowish-white in colour and having nearly the bulk of a grain of wheat, but shorter. The inner wall of the recess is plastered with a greenish-brown matter, shiny, half-fluid, a real cream destined to form the first mouthfuls of the grub. In order to produce this delicate fare, does the mother select the quintessence of the ordure? The appearance of the mess tells me differently and assures me that it is a broth elaborated in the maternal stomach. The Pigeon softens the corn in her crop and turns it into a sort of milk-diet which she afterwards disgorges for her brood. The Dung-beetle has the same fond ways : she half-digests selected viands and disgorges them as a fine pap, with which she hangs the walls of the nest wherein her egg is laid. In this manner, the grub, when hatched, finds an easily-digested food that soon strengthens its stomach and allows it to attack the underlying layers, which are less daintily prepared.

A progressive change of diet is here made manifest. On leaving the egg, the feeble little grub licks the fine

[1] ·39 inch.—*Translator's Note.*

sop on the walls of its lodging. There is not much of it, but it is strengthening and possesses a high nourishing value. The pap of tender childhood is followed by the pottage of the weaned nursling.

The time has come for a sight stranger than any yet displayed to me by the mechanical daring of the insect. Anxious to observe the grub in the intimacy of its home, I open in the belly of the pear a little peep-hole half a centimetre square. The head of the recluse at once appears in the opening, to enquire what is happening. The breach is perceived. The head disappears. I can just see the white chine turning about in the narrow cabin ; and, then and there, the window which I have contrived is closed with a soft, brown paste, which soon hardens.

The inside of the cabin, said I to myself, is no doubt a semi-fluid porridge. Turning upon itself, as is shown by the sudden slide of the back, the grub has collected an armful of this material and, completing the circuit, has stuck its load, by way of mortar, in the breach considered dangerous. I remove the closing plug. The grub acts as before, puts its head at the window, withdraws it, spins round upon itself like a fruit-stone slipping in its shell and forthwith produces a second plug as ample as the first. Forewarned of what was coming, this time I saw more clearly.

What a mistake was mine ! I am not too greatly thunderstruck, however : in the exercise of its defensive skill, the animal often employs methods which our imagination would not dare to contemplate. It is not the head that is presented at the breach, after the preliminary twisting : it is the opposite extremity. The grub does not bring an armful of its alimentary dough,

gathered by scraping the walls: it excretes upon the aperture to be closed; a much more economical proceeding. Sparingly measured out, the rations must not be wasted: there is just enough to live upon. Besides, the cement is of better quality; it soon sets. Lastly, the urgent repairs are more quickly effected, if the intestines lend their kindly aid.

They do, in point of fact, and to an astonishing degree. Five, six times in succession and oftener, I remove the fixed plug; and, time after time, the mortar discharges a copious ejaculation from its apparently inexhaustible reservoir, which is ever at the mason's service, without an interval for rest. The grub is already beginning to resemble the Sacred Beetle, whose stercoral prowess we know: it is a past master in the art of dunging. It possesses above any other animal in the world an intestinal deftness which anatomy will undertake to explain to us, partly, later on.

The plasterer and the mason have their trowels. In the same way, the grub, that zealous repairer of breaches made in its home, has a trowel of its own. The last segment is lopped off slantwise, and carries on its dorsal surface a sort of inclined plane, a broad disk surrounded by a fleshy pad. In the middle of the disk is a gash, forming the cementing-aperture. Behold the fair-sized trowel, flattened out and supplied with a rim to prevent the compressed matter from flowing away in useless waste.

As soon as the plastic gush is laid down in a lump, the levelling and compressing instrument sets to work to introduce the cement well into the irregularities of the breach, to push it right through the thickness of the ruined portion, to give it consistency, to level it. After this

stroke of the trowel, the grub turns round : it comes and bangs and pushes the work with its wide forehead and improves it with the tip of its mandibles. Wait a quarter of an hour and the repaired portion will be as firm as the rest of the shell, so quickly does the cement set. Outside, the repairs are betrayed by the rough prominence of the material forced outwards, which remains inaccessible to the trowel ; but, inside, there is no trace of the breakage : the usual polish has been restored at the injured spot. A plasterer stopping a hole in a wall in our rooms could produce no better piece of work.

Nor do the worm's talents end here. With its cement, it becomes a mender of pots and pans. Let me explain. I have compared the outside of the pear, which, when pressed and dried, becomes a strong shell, with a jar containing fresh food. In the course of my excavations, sometimes made on difficult soil, I have happened occasionally to break this jar with an ill-directed blow of the trowel. I have collected the potsherds, pieced them together, after restoring the worm to its place, and kept the whole thing in one by wrapping it in a bit of old newspaper.

On reaching home, I have found the pear put out of shape, no doubt, and seamed with scars, but just as solid as ever. During the walk, the grub had restored its ruined dwelling to condition. Cement injected into the cracks joined the pieces together ; inside, a thick plastering strengthened the inner wall, so much so that the repaired shell was quite as good as the untouched shell, but for the irregularity of the outside. In its artistically-mended stronghold, the worm found the peace essential to its existence.

Let us now give a brief description of the grub, without stopping to enumerate the articulations of the palpi and antennæ, irksome details of no immediate interest. It is a fat worm and has a fine, white skin, with pale slate-coloured reflections proceeding from the digestive organs, which are visible transparently. Bent into a broken arch or hook, it is not unlike the grub of the Cockchafer, but has a much more ungainly figure, for, on its back, at the sudden bend of the hook, the third, fourth and fifth segments of the abdomen swell into an enormous protuberance, a tumour, a pouch so prominent that the skin seems on the point of bursting under the pressure of the contents. This is the animal's most striking feature : the fact that it carries a wallet.

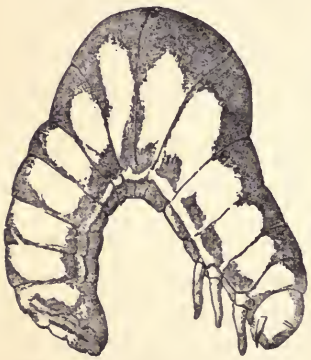


Fig. 3.—Grub of the Sacred Beetle.

The head is small in proportion to the size of the grub, slightly convex and bright red, studded with a few pale bristles. The legs are fairly long and sturdy, ending in a pointed tarsus. The grub does not use them as limbs of progression. Taken from its shell and placed upon the table, it struggles in clumsy contortions without succeeding in shifting its position ; and the cripple betrays its anxiety by repeated eruptions of its mortar.

Let us also mention the terminal trowel, the last segment lopped into a slanting disk and rimmed with a fleshy pad. In the centre of this inclined plane is the open stercoral gash, which thus, by a very unusual inversion,

occupies the upper surface. An enormous hump and a trowel: that gives you the animal in two words.

We must not finish the history of the grub without saying a few words on its internal structure. Anatomy will show us the works wherein the cement employed in so original a manner is manufactured. The stomach or chylific ventricle is a long, thick cylinder, starting from the creature's neck after a very short gullet. It measures about three times the length of the animal. In its last quarter, it carries a voluminous lateral pouch distended by the food. This is a subsidiary stomach in which the supplies are stored so as to yield their nutritive principles more thoroughly. The chylific ventricle is much too long to lie straight in the grub's bowels and bends back upon itself, in front of its appendix, in the form of a large loop occupying the dorsal surface. It is to contain this loop and the lateral pouch that the back is swollen into a protuberance. The grub's wallet is, therefore, a second paunch, an annexe, as it were, of the stomach, which is itself incapable of holding the voluminous digestive apparatus. Four very fine, very long tubulures, irregularly entwined, four Malpighian vessels mark the limits of the chylific ventricle.

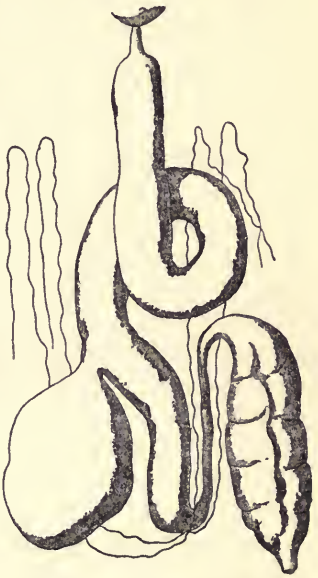


FIG. 4.—Digestive apparatus of the Sacred Beetle.

Next comes the intestine, narrow, cylindrical, rising forwards. The intestine is followed by the rectum, which pushes backwards. This latter, which is of exceptional size and fitted with powerful walls, is wrinkled across, bloated and distended by its contents. Here is the roomy warehouse in which the scoriæ of the digestion accumulate; here is the mighty ejaculator, always ready to provide cement.

The grub gets bigger as it eats the wall of its house from the inside. Little by little, the belly of the pear is scooped out into a cell whose capacity grows in proportion to the growth of the inhabitant. Ensconced in its hermitage, furnished with board and lodging, the recluse waxes stout and fat. What more does it want ?

In four or five weeks, the complete development is obtained. The apartment is ready. The worm sheds its skin and becomes a chrysalis. There are very few in the entomological world to vie in sober beauty with the tender creature which, with its wing-cases laid in front of it like a wide-creased scarf and its fore-legs folded under its head, as when the full-grown Scarab counterfeits death, suggests the idea of a mummy maintained by its bandages in a sacerdotal pose. Semi-translucent and honey-yellow, it looks as though it were cut from a block of amber. Imagine it hardened in this state, mineralized, made incorruptible : it would be a splendid topaz jewel.

In this marvel, so severe and dignified in shape and colouring, one point above all captivates me and gives me at last the solution of a far-reaching problem. Are the front-legs furnished with a tarsus, yes or no ? This is the great business that makes me forget the jewel for the sake of a structural detail. Let us then return to a subject that excited me in my early days ; for the answer

has come at last, late, it is true, but certain and indisputable.

By a very strange exception, the full-grown Sacred Beetle and his congeners are without front tarsi; they lack on their fore-legs that five-jointed finger which is the rule among the highest division of Coleoptera, the Pentamera. The other limbs, on the contrary, follow the common law and possess a very well-shaped tarsus. Is the formation of the toothed armlets original or accidental?

At first sight, an accident seems probable enough. The Scarab is a strenuous miner and a great pedestrian. Always in contact with the rough soil, whether in walking or digging; used, moreover, for constant leverage when the insect is rolling its ball backwards, the fore-legs are much more exposed than the others to the danger of spraining and twisting their delicate finger, of putting it out of joint, of losing it entirely, from the very first moment when the work begins.

Lest this explanation should appeal to any of my readers, I will hasten to undeceive them. The absence of the front fingers is not the result of an accident. The proof of what I say lies here, under my eyes, without the possibility of a rejoinder. I examine the nymph's legs with the magnifying-glass: those in front have not the least vestige of a tarsus; the toothed limb ends bluntly, without a trace of a terminal appendage. In the others, on the contrary, the tarsus is as distinct as possible, notwithstanding the shapeless, gnarled condition due to the swaddling-bands and the humours of the chrysalis state. It suggests a finger swollen with chilblains.

If the evidence of the nymph were not sufficient, there

would be that of the perfect insect which, casting its rejected mummy-clothes and moving for the first time in its shell, wields fingerless armlets. The fact, therefore, is established for certain: the Sacred Beetle is born maimed; his mutilation dates from his birth.

"Very well," reply our fashionable theorists, "the Sacred Beetle is mutilated from the start; but his remote ancestors were not. They were formed according to the general rule, they were correct in structure down to this slight digital detail. There were some who, in the course of their rude task as diggers and rollers, wore out that delicate, cumbrous, useless member; and, finding themselves better equipped for their work by this accidental amputation, they bequeathed it to their successors, to the great benefit of the race. The present insect profits by the improvement obtained by a long array of ancestors, and, acting under the stimulus of vital competition, gives permanence to an advantageous condition due to chance."

O ingenuous theorists, so triumphant on paper, so vain in the face of reality, listen to me for yet one moment more! If the loss of the front fingers be a fortunate thing for the Sacred Beetle, who faithfully hands down the leg of yore fortuitously maimed, why should it not be so with the other members, if they too happened to lose by chance their terminal appendage, a small, powerless filament, almost utterly unserviceable, and, owing to its delicacy, a cause of grievous conflicts with the roughness of the soil?

The Sacred Beetle is not a climber, but an ordinary pedestrian, supporting himself upon the point of an iron-shod stick, by which I mean the stout spine or prickle wherewith the tip of the leg is armed. He does not have to hold on by his claws to some hanging branch, as does

the Cockchafer. And it would therefore, meseems, be entirely to his advantage to rid himself of the four remaining fingers, projecting sideways, idle on the march, inactive in the construction and carriage of the ball. Yes, that would mean progress, for the simple reason that the less hold one gives to the enemy the better. It remains to be seen if chance ever produces this state of things.

It does and very often. At the end of the fine season, in October, when the insect has worn itself out in digging, in carrying balls and in modelling pears, the maimed, the victims of work, form the great majority. I see them, both in my voleries and outside, displaying every degree of amputation. Some have lost the finger on their four hind-legs altogether; others retain a stump, a couple of joints, a single joint; those which are least damaged have a few members left intact.

This is certainly the mutilation pleaded by the theorists. And it is no accident, occurring at long intervals: every year, the cripples outnumber the others at the time when the winter-season is at hand. In their final labours, they seem no more embarrassed than those who have been spared by the trials of life. On both sides, I find the same quickness of movement, the same dexterity in kneading the ammunition-bread which will enable them to bear the first rigours of winter philosophically underground. In the scavenger's work, the maimed vie with the others.

And these cripples form a race; they spend the bad season underground; they wake up in the spring, return to the surface and take part, for a second, sometimes even for a third time, in life's great festival. Their descendants ought to profit by an improvement which

has been renewed year by year, ever since Scarabs came into the world, and which has certainly had time to become fixed and to convert itself into a settled habit. But they do nothing of the sort. Every Sacred Beetle that breaks his shell, with not one exception, is endowed with the four tarsi prescribed by rule.

Well, theorists, what say you to that? For the two front legs, you offer a sort of an explanation; and the four others contradict you flatly. Have you not been taking fancy for truth?

Then what is the cause of the original mutilation of the Scarab? I will confess plainly that I know nothing at all about it. Nevertheless, those two maimed members are very strange: so strange, in the endless order of insects, that they have exposed the masters, the greatest masters, to lamentable blunders. Let us listen first to Latreille,[1] the prince of descriptive entomologists. In his account of the insects which ancient Egypt painted or carved upon her monuments,[2] he quotes the writings of Horapollo, an unique document which has been preserved for us in the papyri for the glorification of the sacred insect:

"One would feel tempted at first," he says, "to set down as fiction what Horapollo says of the number of that Scarab's fingers. According to him, there are thirty. Nevertheless, this computation, judged by the way in which he looks at the tarsus, is perfectly correct, for this part consists of five joints; and, if we take each of them for a finger, the legs being six in number and each ending

[1] Pierre André Latreille (1762-1833), one of the founders of entomological science.—*Translator's Note.*

[2] *Mémoires du Muséum d'histoire naturelle*, vol. v., p. 249.—*Author's Note.*

in a five-jointed tarsus, the Sacred Beetles obviously have thirty fingers."

Forgive me, illustrious master: the total number of joints is but twenty, because the two front legs are devoid of tarsi. You have been carried away by the general law. Losing sight of the singular exception, which was certainly known to you, you said thirty, swayed for a moment by that overwhelmingly positive law. Yes, the exception was known to you, so much so that the figure of the Sacred Beetle accompanying your account, a figure drawn from the insect and not from the Egyptian monuments, is irreproachably accurate: it has no tarsi on its fore-legs. The blunder is excusable, in view of the strangeness of the exception.

What did Horapollo himself see? Apparently what we see in our day. If Latreille's explanation be right, as everything seems to denote, if the Egyptian author began by counting thirty fingers according to the number of joints in the tarsi, it is because his enumeration was based in his mind upon the facts of the general situation. He was guilty of a mistake which was not very reprehensible, seeing that, some thousand years later, masters like Latreille and Mulsant were guilty of it in their turn. The only culprit in all this business is the exceptional structure of the insect.

"But," I may be asked, "why should not Horapollo have seen the exact truth? Perhaps the Scarab of his century had tarsi which the insect does not possess to-day. In that case, it has been altered by the patient work of time."

Before answering this evolutionary objection, I will wait for some one to show me a natural Scarab of Hora-

pollo's date. The hypogea which so religiously guard the cat, the ibis and the crocodile must also contain the sacred insect. All that I have at my disposal is a few figures representing the Sacred Beetle as we find him engraved on the monuments or carved in fine stone as an amulet for the mummies. The ancient artist is remarkably faithful in the execution of the whole; but his graver, his chisel have not troubled about details so insignificant as those of the tarsi.

Ill-supplied though I be with documents of this kind, I greatly doubt whether carving or engraving will solve the problem. Even if an image with front tarsi were discovered somewhere or other, the question would be no further advanced. One could always plead a mistake, carelessness, a leaning towards symmetry. The doubt, as long as it prevails in certain minds, can only be removed by the ancient insect in a natural state. I will wait for it, convinced beforehand that the Pharaonic Scarab differed in no way from our own.

Let us not take leave of the old Egyptian author just yet, in spite of his usually incomprehensible jargon, with its senseless allegories. He sometimes has views that are strikingly correct. Is it a chance coincidence? Or is it the result of serious observation? I should be gladly inclined to adopt the latter opinion, so perfect is the agreement between his statements and certain biological details of which our own science was ignorant until quite lately. Where the intimate life of the Scarab is concerned, Horapollo is much better-informed than ourselves.

In particular, he writes as follows:

"The Scarab buries her ball in the ground, where she remains hidden for twenty-eight days, a space of time

equal to that of a revolution of the moon, during which period the offspring of the Scarab quickens. On the twenty-ninth day, which the insect knows to be that of the conjunction of the sun and moon and of the birth of the world, it opens the ball and throws it into the water. From this ball issue animals that are Scarabs."

Let us dismiss the revolution of the moon, the conjunction of the sun and moon, the birth of the world and other astrological absurdities, but remember this: the twenty-eight days of incubation required by the ball underground, the twenty-eight days during which the Scarab is born to life. Let us also remember the indispensable intervention of water to bring the insect out of its burst shell. These are precise facts, falling within the domain of true science. Are they imaginary? Are they real? The question deserves investigation.

Antiquity knew nothing of the wonders of the metamorphosis. To antiquity, a grub was a worm born of corruption. The poor creature had no future to lift it from its abject condition: as worm it appeared and as worm it had to disappear. It was not a mask under which a superior form of life was being elaborated; it was a definite entity, supremely contemptible and doomed soon to return to the rottenness that gave it birth.

To the Egyptian author, therefore, the Scarab's larva was unknown. And if, by chance, he had had before his eyes the shell of the insect inhabited by a fat, big-bellied worm, he would never have suspected in the foul and ugly animal the sober beauty of the future Scarab. According to the ideas of the time, ideas long maintained, the sacred insect had neither father nor mother: an error excusable in the midst of the simplicity of the

ancients, for here the two sexes are outwardly indistinguishable. It was born of the ordure that formed its ball; and from its birth dated the appearance of the nymph, that amber gem displaying, in a perfectly recognizable form, the features of the full-grown insect.

In the eyes of all antiquity, the Sacred Beetle begins to be born to life at the moment when he can be recognized, not before; else we should have the as yet unsuspected worm of affiliation. The twenty-eight days, therefore, during which, as Horapollo tells us, the offspring of the insect quickens, represent the nymphal phase. This period has been the object of special attention in my studies. It varies, but within narrow limits. The notes taken mention thirty-three days as the longest duration and twenty-one as the shortest. The average, supplied by a score of observations, is twenty-eight days. This identical number twenty-eight, this number of four weeks appears as such and oftener than the others. Horapollo spoke truly: the real insect takes life in the interval of a lunar month.

The four weeks past, behold the Scarab in his final shape: the shape, yes, but not the colouring, which is very strange when the chrysalis casts its skin. The head, legs and thorax are a dark red, except the denticulations, which are a smoky brown. The abdomen is an opaque white; the wing-cases are a transparent white, very faintly tinged with yellow. This majestic dress, combining the red of the cardinal's cassock with the white of the priest's alb, is but temporary and turns darker by degrees, to make way for a uniform of ebon black. About a month is necessary for the horny armour to acquire a firm consistency and a definite hue.

At last, the Scarab is fully matured. Awaking within

him is the delicious restlessness of an approaching liberty. He, hitherto the son of the darkness, foresees the gladness of the light. His longing is great to burst the shell, to emerge from below ground and come into the sun; but the difficulty of liberating himself is far from small. Will he escape from the natal cradle, now become an odious prison? Or will he not escape? It depends.

It is generally in August that the Sacred Beetle is ripe for the delivery: in August, save for rare exceptions, the most torrid, dry and scorching month of the year. Should there not then come, from time to time, a shower that to some slight extent assuages the panting earth, then the cell to be burst and the wall to be broken through defy the strength and patience of the insect, which is powerless against all that hardness. By dint of a prolonged desiccation, the soft original matter has become an insuperable rampart; it has turned into a sort of brick baked in the oven of the dog-days.

I need hardly say that I have not failed to experiment with the insect in these difficult circumstances. Pear-shaped shells are gathered containing the full-grown Scarab, who is on the point of issuing, in view of the lateness of the season. These shells, already dry and very hard, are laid in a box where they retain their aridity. A little earlier in one case, a little later in the other, I hear the sharp grating of a rasp inside each shell. It is the prisoner working to make himself an outlet by scraping the wall with the rake of his shield and fore-feet. Two or three days elapse and the delivery seems to make no progress.

I come to the assistance of a pair of them by myself opening a loop-hole with the point of a knife. According to my idea, this first breach will help the egress of the

recluse by offering him a place to start upon, an exit that only needs widening. But not at all: these favoured ones advance no quicker with their work than the rest.

In less than a fortnight, silence prevails in all the shells. The prisoners, worn out with ineffectual efforts, have perished. I break the caskets containing the deceased. A meagre pinch of dust, representing hardly an average pea in bulk, is all that the sturdy implements—rasp, saw, harrow and rake—have succeeded in sundering from the invincible wall.

Other shells, of a similar hardness, are wrapped in a wet rag and enclosed in a flask. When the moisture has soaked through them, I relieve them of their wrapper and keep them in the corked flask. This time, events take a very different turn. Softened to a nicety by the wet rag, the shells burst, ripped open by the shove of the prisoner, who props himself boldly on his legs, using his back as a lever; or else, scraped away at one point, they crumble to pieces and yawn with a wide breach. The success is complete. In each case, the delivery is effected without impediment; a few drops of water have brought them the joys of the sun.

For the second time, Horapollo was right. Certainly, it is not the mother, as the old author says, who throws her ball into the water: it is the clouds that provide the liberating ablution, the rain that facilitates the ultimate release. In the natural state, things must happen as in my experiments. In August, in a burnt soil, under a thin screen of earth, the shells, baked like bricks, are for most of the time as hard as pebbles. It is impossible for the insect to wear out its casket and escape from it. But, should a shower come upon the scene—that life-giving baptism which the seed of the plant and the

family of the Scarab alike await within the ashes of the soil—should a little rain fall, soon the fields will present the appearance of a resurrection.

The earth is soaked. This is the wet rag of my experiment. At its touch, the shell recovers the softness of its early days, the casket becomes yielding; the insect makes play with its legs, pushes with its back; it is free. It is, in fact, in the month of September, during the first rains which herald the coming autumn, that the Scarab leaves the native burrow and comes to enliven the pastoral sward, even as the former generation enlivened it in the spring. The clouds, hitherto so chary, have come at last to set him free.

Under conditions of exceptional coolness of the earth, the bursting of the shell and the emerging of its occupant can occur at an earlier period; but, in ground scorched by the fierce sun of summer, as is usually the case in these parts, the Scarab, however eager he may be to see the light, must needs wait for the first rains to soften his stubborn shell. A downpour means to him a question of life and death. Horapollo, that echo of the Egyptian magi, saw true when he made water play its part in the insect's birth.

But let us drop the jargon of antiquity and its shreds of truth; let us not neglect the first acts of the Sacred Beetle on leaving his shell; let us be present at his prentice steps in the open-air life. In August, I break the casket in which I hear the helpless prisoner fretting. The insect, the only one of its species, is placed in a volery. Provisions are fresh and plentiful. This is the moment, I say to myself, when we take refreshment after so long an abstinence. Well, I am wrong: the new recruit sets no store by the victuals, notwithstand-

ing my invitations, my appeals to the appetizing heap. What he wants above all is the joys of light. He climbs the metal trellis, sets himself in the sun and there, motionless, takes his fill of its beams.

What passes through his dull-witted scavenger's brain during this first bath of radiant light ? Probably nothing. He enjoys the unconscious happiness of a flower blooming in the sun.

At last, the insect goes to the victuals. A ball is constructed according to all the rules. There is no apprenticeship, no first attempt : the spherical form is obtained as regularly as though after long practice. A burrow is dug wherein to eat in peace the lately-kneaded bread. Here we find the novice thoroughly versed in his art. No experience, however prolonged, will add anything to his talents.

# THE SPANISH COPRIS

## CHAPTER V

### THE SPANISH COPRIS

To show instinct performing on behalf of the egg what reason, ripened by study and experience, would advise is a result of no mean philosophic import; and I find myself seized with a scruple aroused by scientific austerity. Not that I wish to give science a forbidding aspect: I am convinced that one can say excellent things without employing a barbarous vocabulary. Clearness is the supreme politeness of whoso wields a pen. I do my best to observe it. And the scruple that stops me is of another kind.

I ask myself if I am not here the victim of an illusion. I say to myself:

"The Sacred Beetles and others are manufacturers of balls, of pills. That is their trade, learnt we know not how, prescribed perhaps by their structure, in particular by their long legs, some of which are slightly curved. When working for the egg, what wonder if they continue underground their special craft as ball-making artisans?"

Setting aside the neck of the pear and the jutting tip of the ovoid, details the interpretation of which presents quite other difficulties, there remains the most important mass as regards bulk, the globular mass, a repetition of that which the insect makes outside the burrow; there

remains the ball with which the Sacred Beetle plays in the sun, sometimes without making any other use of it.

Then what does the globulous form, which presents the most efficacious preventative against desiccation during the heat of summer, do here? Physically, this property of the sphere and of its near neighbour, the ovoid, is undeniable; but these shapes offer only a casual concord with the difficulty overcome. The animal built to roll balls across the fields also fashions balls underground. If the worm be all the better for finding tender foodstuffs under its mandibles to the very end, that is a capital thing for the worm, but it is no reason why we should extol the instinct of the mother.

To complete my conviction, I shall need a portly Dung-beetle who is a total stranger to the pill-making craft in matters of every-day life and who, nevertheless, when the moment of laying is at hand, makes a sudden change in her habits and shapes her harvest into a ball. Is there any such in my neighbourhood? Yes, there is; and she is one of the handsomest and largest, next to the Sacred Beetle. I speak of the Spanish Copris, who is so remarkable for her suddenly sloping corselet and for the extravagant horn surmounting her head.

Thick-set, round, dumpy, slow of gait, the Spanish Copris is certainly not equal to the athletic performances of the Sacred Beetle. The legs, of very middling length and folded under the belly at the least alarm, bear no comparison with the stilts of the pill-rollers. Their stiff and stunted form alone is enough to tell us that the insect would not care to wander about hampered by a rolling ball.

The Copris is, in point of fact, of a sedentary habit.

Once he has found his provisions, at night or in the evening twilight, he digs a burrow under the heap. It is a rough cave, large enough to hold a big apple. Here is introduced, piecemeal, the matter forming the roof or, at least, lying on the door-sill; here is engulfed, without definite shape, an enormous supply of victuals, bearing eloquent witness to the insect's gluttony. As long as the hoard lasts, the Copris, engrossed in the pleasures of the table, does not return to the surface. The hermitage is not abandoned until the larder is emptied, when the insect recommences its nocturnal searches, finds a new treasure and digs itself a new temporary establishment.

Plying this trade as a setter-in of ordure without preliminary manipulation, the Copris, evidently, is absolutely ignorant, for the time being, of the art of kneading and modelling a globular loaf. Besides, his short, awkward legs seem radically opposed to any such art.

In May, or June at latest, comes laying-time. The insect, itself so ready to fill its belly with the most sordid materials, becomes particular, where the portion of its family is concerned. Like the Sacred Beetle, it now wants the soft produce of the sheep, deposited in a single lump. Even when copious, the cake is buried on the spot in its entirety. Not a trace of it remains outside. Economy demands that it be gathered to the last crumb.

You see: no journey, no carting, no preparations. The cake is carried down to the cellar by armfuls and at the identical spot where it is lying. The insect repeats, with an eye to its grubs, what it did when working for itself. As for the burrow, which is marked by a large mole-hill, it is a roomy cave dug at a depth of some

twenty centimetres.[1] I observe a greater width, a greater perfection than in the temporary abodes occupied by the Copris at times of revelry.

But let us leave the insect working in a state of liberty. The evidence supplied by chance meetings would be incomplete, fragmentary and disconnected. An examination in the volery is much to be preferred ; and the Copris lends himself to this most admirably. Let us first watch the storing.

In the discreet dusk of the twilight, I see him appear on the threshold of his burrow. He has mounted from the depths, he has come to gather his harvest. He has not long to seek : the provisions are there, outside the door, plentifully served and renewed by my care. Timidly, prepared to retreat at the least alarm, he walks up to them with a slow and measured step. The shield cuts and rummages, the fore-legs extract. An armful is separated from the rest, quite a modest armful, crumbling to pieces. The Copris drags it backwards and disappears underground. In less than two minutes, he is back again. Never forgetting his caution, he questions the neighbouring space with the outspread leaflets of his antennæ before crossing the threshold of his dwelling.

A distance of two or three inches separates him from the heap. It is a serious matter for him to venture so far. He would have preferred the victuals exactly over his door, forming a roof to the house. This would avoid his having to go out, always a source of anxiety. I have decided otherwise. To facilitate my observations, I have placed the victuals just on one side. Little by little, the alarmist grows accustomed to the open air and accustomed to my presence, which, for that matter, I

[1] About eight inches.—*Translator's Note.*

render as discreet as possible. The taking down of the armfuls is repeated indefinitely. They are always shapeless scraps, morsels such as one might pick off with a small pair of pincers.

Having learnt what I want to know about the method of warehousing, I leave the insect to its work, which continues for the best part of the night. On the following days, nothing : the Copris goes out no more. Enough treasure has been amassed in a single night's sitting. Let us wait a while and leave the insect time to stow its harvest as it pleases.

Before the week is out, I dig up the soil of the volery and lay bare the burrow, the victualling of which I have partly followed. As in the fields, it is a spacious hall, with an irregular, surbased ceiling and an almost level floor. In a corner is a round hole, similar to the orifice of the neck of a bottle. This is the business-entrance, opening on a slanting gallery that runs up to the surface. The walls of the house dug in fresh soil are carefully piled up and possess enough power of resistance not to give way under the disturbance produced by my excavations. We can see that, in labouring for the future, the insect has put forth all its talent, all its strength as a digger, to produce lasting work. Whereas the marquee in which we feast is a cavity hurriedly hollowed out, our permanent dwelling is a crypt of larger dimensions and of a much more finished construction.

I suspect that both sexes take part in the master work : at least, I often come upon the couple in the burrows destined for the laying. The roomy and luxurious apartment was no doubt once the wedding-hall ; the marriage was consummated under the great vault to the building of which the swain has contributed : a

gallant way of declaring his ardour. I also suspect the husband of lending a hand to his partner with the harvesting and the storing. From what I have gathered, he too, strong as he is, collects his armfuls and goes down into the crypt. The minute and tricky work goes much faster with two helping. But, once the house is well supplied, he retires discreetly, returns to the surface and goes and settles down elsewhere, leaving the mother to her delicate functions. His part in the family-mansion is ended.

Now what do we find in this mansion, to which we have seen so many tiny loads of provisions lowered ? A muddled heap of separate morsels ? Not in the least. I always find a single lump, a huge loaf which fills the box, but for a narrow passage all around, just wide enough to leave the mother room to move.

This sumptuous lump, a real Twelfth-Night cake, has no fixed shape. I come across some that are ovoid, suggesting a turkey's egg in form and size ; I find some that are a flattened ellipsoid, similar to the common onion ; I discover some that are almost round, reminding one of a Dutch cheese ; I see some that are circular and slightly raised on the upper surface, like the loaves of the Provençal rustic or, better still, the *fougasso à l'iôu*[1] wherewith the Easter festival is celebrated. In every case, the surface is smooth and regularly curved.

There is no mistaking what has happened : the mother has collected and kneaded into one lump the numerous fragments brought down one after the other ; out of all those particles she has made a homogeneous piece, by dint of mashing them, amalgamating them, stamping

[1] An egg-shaped cake baked in Provence at Easter.—*Translator's Note.*

on them. I repeatedly surprise the baker on the top of the colossal loaf beside which the Sacred Beetle's pill cuts so poor a figure: she goes strolling about on the convex surface, which sometimes measures a decimetre[1] across; she pats the mass, consolidates it, levels it. I can give but a glance at the curious scene. As soon as she is perceived, the pastry-cook slides down the curved slope and huddles out of sight beneath the pie.

To follow the work further, to study its close detail, we must resort to artifice. The difficulty is almost *nil*. Either my long practice with the Sacred Beetle has made me more skilful in methods of research, or else the Copris is less circumspect and endures more readily the annoyance of a long captivity; for I succeed, without the least impediment, in following all the phases of the nest-making at my heart's ease.

I employ two methods, each fitted to instruct me as to certain particulars. Whenever the voleries supply me with a few large cakes, I move these, with the mother, and place them in my study. The receptacles are of two sorts, according to whether I want light or darkness. For light, I employ glass jars with a diameter more or less the same as that of the burrows, say about a dozen centimetres.[2] At the bottom of each is a thin layer of fresh sand, quite insufficient to allow the Copris to bury herself in it, but convenient, nevertheless, to save the insect from the slippery footing provided by the glass and to give it the illusion of a soil similar to that of which I have deprived it. On this layer the jar receives the mother and her loaf.

I need hardly say that the startled insect would not

[1] 3·93 inches.—*Translator's Note.*
[2] Four to five inches.—*Translator's Note.*

undertake anything under conditions of light, however softly modulated. It demands complete obscurity, which I produce by means of a cardboard box encasing the cylinder. By carefully raising this box a little, I am able, presently, when I feel inclined, to surprise the captive at her work and even to follow her doings for a time. The method, the reader will see, is much simpler than that which I used when I wished to see the Sacred Beetle engaged in modelling her pear. The easier-going mood of the Copris lends itself to this simplification, which would be none too successful with the other. A dozen of these eclipsed apparatus are thus arranged on the large table in the laboratory. Any one seeing the set would take them for an assortment of groceries in whity-brown paper bags.

For darkness, I use flower-pots filled with fresh, heaped sand. The mother and her cake occupy the lower portion, which is arranged as a nest by means of a cardboard screen forming a ceiling and supporting the sand above. Or else I simply put the mother on the surface of the sand with a supply of provisions. She digs herself a burrow, does her warehousing, makes herself a nest and things happen as usual. In all cases, a sheet of glass used as a lid answers for my prisoners' safety. I rely upon these several dark apparatus to inform me about a delicate point the particulars whereof will be set forth in their proper place.

What do the glass jars covered with an opaque sheath teach us ? They teach us much, of a most interesting character, and this to begin with : the big loaf does not owe its curve—which is always regular, notwithstanding its varying form—to any rolling process. The inspection of the natural burrow has already told us that so large

a mass could not have been rolled into a cavity of which it fills almost the whole space. Besides, the strength of the insect would be unequal to moving so great a load.

Questioned from time to time, the jar repeats the same conclusion for our benefit. I see the mother, hoisted atop the piece, feeling here, feeling there, bestowing little taps, smoothing away the projecting points, perfecting the thing ; never do I catch her looking as though she wanted to turn the block. It is as clear as daylight : rolling has nothing whatever to do with the matter.

The dough-maker's assiduity, her patient cares make me suspect a delay in the manufacture whereof I was far from dreaming. Why so many after-touches to the block, why so long a wait before employing it ? A week and more passes, in fact, before the insect, ever pressing and polishing, decides to use its hoard.

The baker, when he has kneaded his dough to the desired extent, collects it into a single heap in a corner of the kneading-trough. The heat of the panary fermentation smoulders better in the heart of the voluminous mass. The Copris knows this secret of the bake-house. She collects the sum total of her harvests into a single lump ; she carefully kneads the whole into a provisional loaf which she gives time to improve by means of an inner labour that makes the paste more palatable and gives it a degree of consistency favourable to subsequent manipulations. As long as the chemical work remains unfinished, both the journeyman-baker and the Copris wait. To the insect this means a long spell, a week at least.

It is done. The baker's man divides his lump into smaller lumps, each of which will become a loaf. The

Copris acts likewise. By means of a circular gash made with the cleaver of the shield and the saw of the fore-legs, she separates from the main body a section of the prescribed size. For this stroke of the trencher, no hesitation is needed, no after-touches that add or subtract. Off-hand and with a plain, decisive cut, a lump is obtained of the requisite bulk.

It now becomes a question of shaping it. Clasping it as best it can in its short arms, so incompatible, one would think, with work of this kind, the insect rounds the section by the one and only means of pressure. It gravely moves about the hitherto shapeless ball, climbs up, climbs down; it turns to left and right, above and below; methodically, it presses a little more here, a little less there; it improves by new touches, with unchanging patience; and, in twenty-four hours' time, the angular piece has become a perfect sphere, the size of a plum. In a corner of her crammed studio, the podgy artist, with hardly room to move, has finished her work without once shaking it on its base; by dint of time and patience, she has obtained the geometrical globe which her clumsy tools and her confined space seemed bound to refuse her.

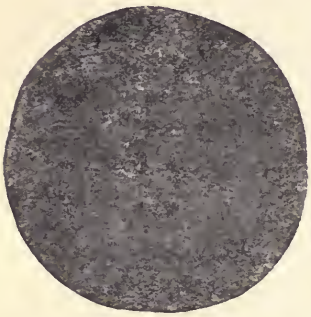


FIG. 5.—The Copris's pill: first state.

The insect continues for a long time yet to improve and lovingly to polish its sphere, gently passing its foot to and fro until the least protuberance has disappeared. Its finikin after-touches look as though they would never

1 and 2. The Spanish Copris, male and female.

3. The pair jointly kneading the big loaf, which, divided into egg-shaped pills, will furnish provisions for each grub of the brood.

4. The mother alone in her burrow: five pills are already finished; a sixth is in process of construction.

be done. Towards the end of the second day, however, the globe is pronounced right and proper. The mother climbs to the dome of her edifice and there, still by simple pressure, hollows out a shallow crater. In this basin the egg is laid.

Then, with extreme caution, with a delicacy that is most surprising in such rough tools, the lips of the crater are brought together so as to form a vaulted roof over the egg. The mother slowly turns, rakes a little, draws

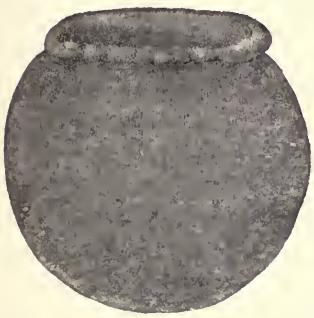


FIG. 6.—The Spanish Copris's pill dug out cupwise to receive the egg.

FIG. 7.—The Spanish Copris's pill: section showing the hatching-chamber and the egg.

the material upwards and finishes the closing. This is the most ticklish work of all. A careless pressure, a miscalculated thrust might easily jeopardize the life of the germ under its slender ceiling.

From time to time, the work of closing is suspended. The mother, motionless, with lowered forehead, seems to auscultate the underlying cavity, to listen to what is happening within. All's well, it seems; and the patient labour is resumed: a fine scraping of the sides towards

the summit, which tapers a little and lengthens out. In this way, an ovoid with the small end uppermost replaces the original sphere. Under the more or less projecting nipple is the hatching-chamber, with the egg. Twenty-four hours more are spent in this minute work. Total: four times round the clock and sometimes longer to construct the sphere, hollow it out basinwise, lay the egg and shut it in by transforming the sphere into an ovoid.

The insect goes back to the cut loaf and helps itself to a second slice, which, by the same manipulations as before, becomes an ovoid sheltering an egg. The surplus suffices for a third ovoid, pretty often even for a fourth. I have never seen this number exceeded when the mother had at her disposal only the materials which she had heaped up in the burrow.

The laying is over. Here is the mother in her retreat, which is almost filled by the three or four cradles standing one against the other, with their poles jutting upwards. What will she do now? Go away, no doubt, to recruit her strength a little out of doors, after a prolonged fast. He who thinks this is mistaken. She remains. And yet she has eaten nothing since she came underground, taking good care not to touch the loaf, which, divided into equal portions, will be the food of the family. The Copris is touchingly scrupulous in the matter of the inheritance: she is a devoted mother, who braves hunger lest her offspring should starve.

She braves it for a second reason: to mount guard around the cradles. From the end of June onwards, the burrows are hard to find, because the mole-hills disappear through the action of some storm, or the wind, or the feet of the passers-by. The few which I succeed in discovering always contain the mother dozing beside a

group of pills, in each of which a grub, now nearing its complete development, feasts on the fat of the land.

My dark apparatus, flower-pots filled with fresh sand, confirm what the fields have taught me. Buried with provisions in the first fortnight in May, the mothers do not reappear on the surface, under the glass lid. They keep hidden in the burrow after laying their eggs; they spend the sultry dog-days with their ovoids, watching them, no doubt, as the glass jars, rid of subterranean mysteries, tell us.

They come up again at the time of the first autumnal rains, in September. But by then the new generation has attained its perfect form. The mother, therefore, enjoys underground that rare privilege for the insect, the delight of knowing her family; she hears her sons scratching at the shell to obtain their liberty; she is present at the bursting of the casket which she has fashioned so conscientiously; maybe she helps the exhausted weaklings, if the ground have not been cool enough to soften their cells. Mother and progeny leave the subsoil together and arrive together at the autumn banquets, when the sun is mild and the ovine manna plentiful along the paths.

# THE ONTHOPHAGI

## CHAPTER VI

### THE ONTHOPHAGI

After the notabilities of the Dung-beetle tribe, there remain, in the very limited radius of my research, the small fry of the Onthophagi, of whom I could gather a dozen different species around my house. What will these little ones teach us ?

Even more zealous than their larger comrades, they are the first to hasten to the exploiting of the heap left by the passing mule. They come up in crowds and stay long, working under the spread table that gives them shade and coolness. Turn over the heap with your foot. You will be surprised at the swarming population whose presence no outward sign betrayed. The largest are scarce the size of a pea, but many are much smaller still, are dwarfs, no less busy than the others, no less eager to crumble the filth whose prompt disappearance the public health demands.

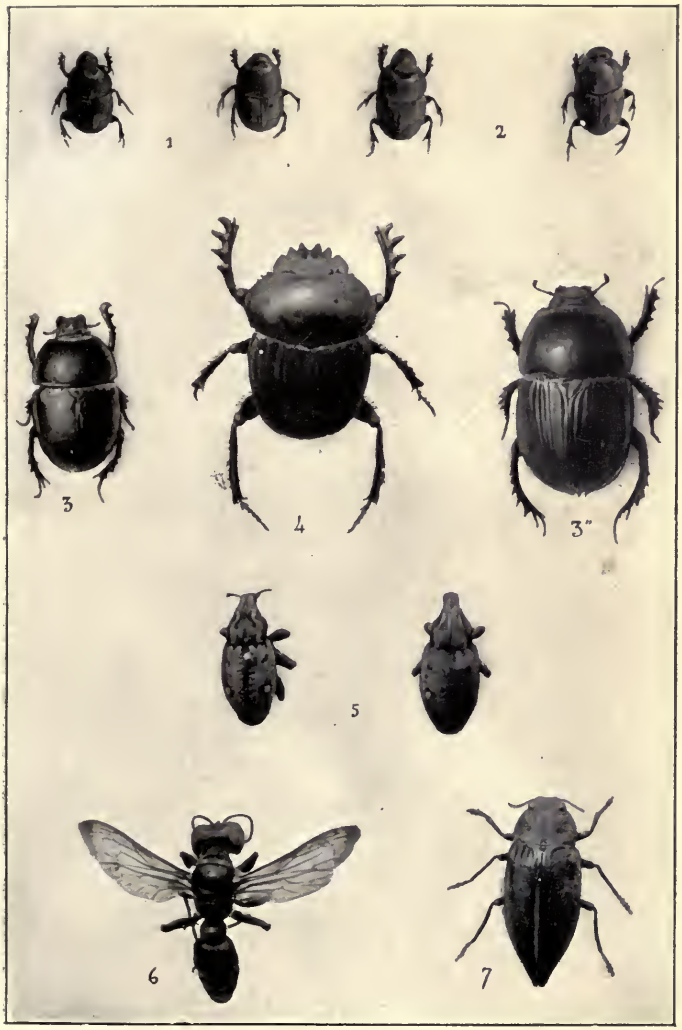
In works of major interest, there is none like the humble, with their concerted weakness, for realizing immense strength. Swollen by numbers, the next to nothing becomes an enormous total.

Hurrying in detachments at the first news of the event, assisted moreover in their wholesome task by their partners, the Aphodians, who are as weak as they, the tiny Onthophagi soon clear the ground of its dirt. Not that

their appetite is equal to the consumption of such plentiful provisions. What food do those pigmies need ? An atom. But that atom, selected from among the exudations, must be hunted amid the fragments of the masticated fodder. Hence, an endless division and subdivision of the lump, reducing it to crumbs which the sun sterilizes and the wind dispels. As soon as the work is done—and very well done—the troop of scavengers goes in search of another refuse-yard. Outside the period of intense cold, which puts a stop to all activity, they know no dead season.

And do not run away with the idea that this filthy task entails an inelegant shape and a ragged dress. The insect knows none of our squalor. In its world, a navvy dons a sumptuous jerkin ; an undertaker decks himself in a triple saffron sash ; a wood-cutter works in a velvet coat. In like manner, the Onthophagus has his own luxury. True, the costume is always severe : brown and black are the predominant colours, now dull, now polished as ebony ; but, on this background, what details of sober and graceful ornament ! The graver's work completes the beauty of the dress. Tiny chasings in parallel grooves, gnarly beads, dainty rows of knobs, seed-plots of pearly papillæ are distributed in profusion among nearly all of them. Yes, the little Onthophagi, with their stunted bodies and their nimble activity, are really pretty to look at.

And then how original are their frontal decorations ! These peace-lovers delight in the panoply of war, as though they, the inoffensive ones, thirsted for battle. Many of them crown their heads with threatening horns. Let us mention that horned one whose story will occupy us more particularly. I mean Onthophagus




1. *Onthophagus Taurus.* 2. *Onthophagus Vacca.*
3. The Stercoraceous Geotrupe. 4. The Wide-necked Scarab.
5. *Cleonus Opthalmicus.* 6. *Cerceris Tuberculata.* 7. *Buprestis Ærea.*

Taurus, clad in raven black. He wears a pair of long horns, gracefully curved and branching to either side. No pedigree bull, in the Swiss meadows, can match them for curve or elegance.

The Onthophagus is a very indifferent artist: his nest is a rudimentary piece of work, hardly fit to be acknowledged. I obtain it in profusion from the six species which I have brought up in my jars and flower-pots. Onthophagus Taurus alone provides me with nearly a hundred; and I find no two precisely alike, as pieces should be that come from the same mould and the same laboratory.

To this lack of exact similarity, we must add inaccuracy of shape, now more, now less accentuated. It is easy, however, to recognize among the bulk the prototype from which the clumsy nest-builder works. It is a sack shaped like a thimble and standing erect, with the spherical thimble-end at the bottom and the circular opening at the top.

Sometimes, the insect establishes itself in the central region of my apparatus, in the heart of the earthy mass; then, the resistance being the same in every direction, the sack-like shape is pretty accurate. But, generally, the Onthophagus prefers a solid basis to a dusty support and builds against the walls of the jar, especially against the bottom wall. When the support is vertical, the sack is a short cylinder divided lengthwise, with a smooth, flat surface against the glass and a rugged convexity every elsewhere. If the support be horizontal, as is most frequently the case, the cabin is a sort of undefined oval pastille, flat at the bottom, bulging and vaulted at the top. To the general inaccuracy of these contorted shapes, ruled by no very definite pattern, we must add the coarseness of the surfaces, all of which, with the

exception of the parts touching the glass, are covered with a crust of sand.

The manner of procedure explains this uncouth exterior. As laying-time draws nigh, the Onthophagus bores a cylindrical pit and descends underground to a middling depth. Here, working with the shield, the chine and the fore-legs, which are toothed like a rake, he forces back and heaps around him the materials which he has moved, so as to obtain as best he may a nest of suitable size.

The next thing is to cement the crumbling walls of the cavity. The insect climbs back to the surface by way of its pit ; it gathers on its threshold an armful of mortar taken from the cake whereunder it has elected to set up house ; it goes down again with its burden, which it spreads and presses upon the sandy wall. Thus it produces a concrete casing, the flint of which is supplied by the wall itself and the cement by the produce of the sheep. After a few trips and repeated strokes of the trowel, the pit is plastered on every side ; the walls, encrusted with grains of sand, are no longer liable to give way.

The cabin is ready : it now wants only a tenant and stores. First, a large free space is contrived at the bottom : the hatching-chamber, on whose inner wall the egg is laid. Next comes the gathering of the provisions intended for the worm, a gathering made with nice precautions. Lately, when building, the insect worked upon the outside of the doughy mass and took no notice of the earthy blemishes. Now, it penetrates to the very centre of the lump, through a gallery that looks as though it were contrived with a punch. When trying a cheese, the buyer employs a hollow cylindrical taster, which he

drives well in and pulls out with a sample taken from the middle of the cheese. The Onthophagus, when collecting for her grub, goes to work as though equipped with one of these tasters. She bores an exactly round hole into the piece which she is exploiting; she goes straight to the middle, where the material, not being exposed to the contact of the air, has kept more savoury and pliable. Here and here alone are gathered the armfuls which, gradually stowed away, kneaded and heaped up to the requisite extent, fill the sack to the top. Finally, a plug of the same mortar, the sides of which are made partly of sand and partly of stercoral cement, roughly closes the cell, in such a way that an outward inspection does not allow one to distinguish front from back.

To judge the work and its merit, we must open it. A large empty space, oval in shape, occupies the rear end. This is the birth-chamber, huge in dimensions compared with its content, the egg fixed on the wall, sometimes at the bottom of the cell and sometimes on the side. The egg is a tiny white cylinder, rounded at either end and measuring a millimetre[1] in length immediately after it is laid. With no other support than the spot on which the oviduct has planted it, it stands on its hind-end and projects into space.

A more or less enquiring glance is quite surprised to find so small a germ contained in so large a box. What does that tiny egg want with all that space? When carefully examined within, the walls of the chamber prompt another question. They are coated with a fine greenish pap, semi-fluid and shiny, the appearance of which does not agree with the outward or inward aspect of the lump from which the insect has extracted its

[1] ·039 inch.—*Translator's Note.*

materials. A similar lime-wash is observed in the nest which the Sacred Beetle, the Copris, the Sisyphus, the Geotrupe and other makers of stercoraceous preserves contrive in the very heart of the provisions, to receive the egg ; but nowhere have I seen it so plentiful, in proportion, as in the hatching-chamber of the Onthophagus. Long puzzled by this brothy wash, of which the Sacred Beetle provided me with the first instance, I began by taking the thing for a layer of moisture oozing from the bulk of the victuals and collecting on the surface of the enclosure without other effort than capillary action. That was the interpretation which I accepted originally.

I was wrong. The truth is worthy of attention in a very different way. To-day, better-informed by the Onthophagus, I know that this lime-wash itself, this semi-fluid cream, is the product of maternal foresight.

What, then, is this lime-wash found in every cell ? The answer is compulsory : it is a produce of the mother, a special gruel, a milk-food elaborated for the benefit of the new-born grub.

The young Pigeon puts his beak into that of his parents, who, with convulsive efforts, force down his gullet first a caseous mash secreted in the crop and next a broth of grains softened by being partially digested. He is fed upon disgorged foods, which are helpful to the weaknesses of an inexperienced stomach. The grub of the Onthophagus is brought up in much the same way, at the start. To assist its first attempts at swallowing, the mother prepares for it, in her crop, a light and strengthening cream.

To pass the dainty from mouth to mouth is, in her case, impossible : the construction of other cells keeps her busy elsewhere. Moreover—and this is a more serious detail—the laying takes place egg by egg, at very long

intervals, and the hatching is pretty slow : time would fail, had the family to be brought up in the manner of the Pigeons. Another method is perforce needed. The childish pap is disgorged all over the walls of the cabin in such a way that the nursling finds itself surrounded by an abundance of bread-and-jam, in which the bread, the food of the sturdy age, is represented by the uncooked material, as supplied by the sheep, whereas the jam, the mess of the puny age, is represented by the same material daintily prepared beforehand in the mother's stomach. We shall see the babe presently lick first the jam, all around it, and then stoutly attack the bread. A child among ourselves would behave no otherwise.

I should have liked to catch the mother in the act of disgorging and spreading her broth. I was not able to succeed. Things happen in a narrow retreat, which the eye cannot enter when the pastry-cook is busy ; and also her fluster at being exhibited in broad daylight at once stops the work.

If direct observation be lacking, at least the appearance of the material speaks very clearly and tells us that the Onthophagus, here rivalling the Pigeon, but with a different method, disgorges the first mouthfuls for her sons. And the same may be said of the other Dung-beetles skilled in the art of building a hatching-chamber in the centre of the provisions.

No elsewhere, in the insect order, except among the Apidæ, who prepare disgorged food in the shape of honey, is this affection present. The Dung-workers edify us with their morals. Several of them practise association in couples and found a household ; several anticipate the suckling, the supreme expression of maternal solicitude, by turning their crop into a nipple. Life has its freaks.

It settles amid ordure the creatures most highly-endowed with family qualities. True, from there it mounts, with a sudden flight, to the sublimities of the bird.

The little worm is hatched in about a week : a strange and paradoxical being. On its back, it has an enormous sugar-loaf hump, the weight of which drags it over and capsizes it each time it tries to stand on its legs and walk. At every moment, it staggers and falls under the burden of the hunch.

Unable to keep its hump upright, the grub of the Onthophagus lies down on its side and licks the cream of its cell all around it. There is cream everywhere, on the ceiling, on the walls, on the floor. As soon as one spot is thoroughly bared, the consumer moves on a little with the help of its well-shaped legs ; it capsizes again and starts licking again. The room is large and plentifully supplied ; and the jam-diet lasts some time.

The fat babies of the Geotrupe, the Copris and the Sacred Beetle finish at one brief sitting the dainty wherewith their cabined lodge is hung, a dainty scantily served and just sufficient to stimulate the appetite and prepare the stomach for a coarser fare ; but the Onthophagus grub, that lean pigmy, has enough to last it for a week and more. The spacious natal chamber, which is out of all proportion with the size of the nursling, has permitted this wastefulness.

At last, the real loaf is attacked. In about a month, everything is consumed, except the wall of the sack. And now the splendid part played by the hump stands revealed. Glass tubes, prepared in view of events, allow me to follow the more and more plump and hunch-backed grub at work. I see it withdraw to one end of the cell, which has become a crumbling ruin. Here it builds a

casket in which the transformation will take place. Its materials are the digestive residuum, converted into mortar and heaped up in the hump. The stercoral architect is about to construct a masterpiece of elegance out of its own ordure, held in reserve in that receptacle.

I follow its movements under the magnifying-glass. It buckles itself, closes the circuit of the digestive apparatus, brings the two poles into contact and, with the end of its mandibles, seizes a pellet of dung ejaculated at that moment. This pellet, moulded and measured to perfection, is very neatly gathered. A slight bend of the neck sets the rubble-stone in place. Others follow, laid one above the other in minutely regular courses. Giving a tap here and there with its feelers, the grub makes sure of the stability of the parts, their accurate binding, their orderly arrangement. It turns round in the centre of the work as the edifice rises, even as a mason does when building a tower.

Sometimes, the laid stone becomes loose, because the cement has given way. The worm takes it up again with its mandibles, but, before replacing it, coats it with an adhesive moisture. It holds it to its anus, whence trickles, on the moment, almost imperceptibly, a gummy consolidating extract. The hump supplies the materials ; the intestines give, if necessary, the connecting glue.

In this way, a nice house is produced, ovoid in shape, polished as stucco within and adorned on the outside with slightly projecting scales, similar to those on a cedar-cone. Each of these scales is one of the rubble-stones out of the hump. The casket is not large : a cherry-stone would about represent its dimensions ; but it is so accurate, so prettily fashioned that it will bear comparison with the finest products of entomological industry.

## CHAPTER VII

### A BARREN PROMISE

In the nymph of Onthophagus Taurus there rises, on the front edge of the corselet, a single horn, as strong as the two others and shaped like a cylinder ending in a conical knob. It points forward and is fixed in the middle of the frontal crescent, projecting a little beyond it. The arrangement is gloriously original. The carvers of hieroglyphics would have beheld in it the crescent of Isis wherein dips the edge of the world.

Other singularities complete the curious nymph. To right and left, the stomach is armed, on either side, with four little horns resembling crystal spikes. Total, eleven pieces on the harness: two on the forehead; one on the thorax; eight on the abdomen. The beast of yore delighted in queer horns: certain reptiles of the geological period stuck a pointed spur on their upper eyelids. The Onthophagus, more daring, sports eight on the sides of his belly, in addition to the spear which he plants upon his back. The frontal horns may be excused: they are pretty generally worn; but what does he propose to do with the others? Nothing. They are passing fancies, jewels of early youth; the adult insect will not retain the least trace of them.

The nymph matures. The appendages of the forehead, at first quite crystalline, now show, transparently, a streak

of reddish brown, curved arc-wise. These are real horns taking shape, consistency and colour. The appendage of the corselet and those of the belly, on the other hand, preserve their glassy appearance. They are barren sacks, void of any self-developing germ. The organism produced them in an impetuous moment ; now, scornful, or perhaps powerless, it allows the work to wither and become useless.

When the nymph sheds its covering and the fine tunic of the adult form is torn, these strange horns crumble into shreds, which fall away with the rest of the cast clothing. In the hope of finding at least a trace of the vanished things, the lens in vain explores the bases but lately occupied. There is nothing appreciable left : smoothness takes the place of protuberance ; nullity succeeds to reality. Of the accessory panoply that promised so much, absolutely naught remains : everything has disappeared, evaporated, so to speak.

Onthophagus Taurus is not the only one endowed with those fleeting appendages, which vanish wholly when the nymph sheds its clothes. The other members of the tribe possess similar horny manifestations on their bellies and corselets. These all disappear entirely in the perfect insect.

A simple setting forth of the facts does not suffice us : we should like to guess at the motive of this corniculate display. Is it a vague memory of the customs of olden time, when life spent its excess of young sap upon quaint creations, banished to-day from our better-balanced world ? Is the Onthophagus the dwarfed representative of an old race of horned animals now extinct ? Does it give us a faint image of the past ?

The surmise rests upon no valid foundation. The

Dung-beetle is recent in the general chronology of created beings; he ranks among the last-comers. With him there is no means of going back to the mists of the past, so favourable to the invention of imaginary precursors. The geological layers and even the lacustrian layers, rich in Diptera and Weevils, have so far furnished not the slightest relic of the Dung-workers. This being so, it is wiser not to refer to distant horned ancestors as accounting for their degenerate descendant, the Onthophagus.

Since the past explains nothing, let us turn to the future. If the thoracic horn be not a reminiscence, it may be a promise. It represents a timid attempt, which the ages will harden into a permanent weapon. It lets us assist at the slow and gradual evolution of a new organ; it shows us life working on a portion of the adult's corselet, which does not yet exist, but which is to exist some day. We take the genesis of the species in the act; the present teaches us how the future is prepared.

And what does the insect that has conceived the ambition of later planting a spear upon its chine propose to make of its projected work? At least as an adjunct of masculine finery, the thing is in fashion among various foreign Scarabs that feed themselves and their grubs on vegetable matters in a state of decomposition. These giants among the wing-cased tribe delight in associating their placid corpulence with halberds terrible to gaze upon.

Look at this one—Dynastes Hercules his name—an inmate of the rotten tree-stumps under the torrid West-Indian skies. The peaceable colossus well deserves his name: he measures three inches long. Of what service can the threatening rapier of the corselet and the toothed lifting-jack of the forehead be to him, unless it

be to make him look grand in the presence of his female, herself deprived of these extravagances ? Perhaps also they are of use to him in certain works, even as the trident helps Minotaurus in crumbling the pellets and carting the rubbish. Implements of which we do not know the use always strike us as singular. Having never associated with the West-Indian Hercules, I must content myself with suspicions touching the purpose of his fearsome equipment.

Well, one of the subjects in my voleries would achieve a similar savage finery if he persisted in his attempts. I speak of Onthophagus Vacca. His nymph has on its forehead a thick horn, one only, bent backward ; on its corselet it possesses a like horn, jutting forward. The two, approaching their tips, look like a sort of pincers. What does the insect lack in order to acquire, on a smaller scale, the eccentric ornament of the West-Indian Scarab ? It lacks perseverance. It matures the appendage of the forehead and allows that of the corselet to perish atrophied. It succeeds no better than Onthophagus Taurus in its attempt to grow a pointed stake upon its chine ; it loses a glorious opportunity of making itself fine for the wedding and terrible in battle.

The others are no more successful. I bring up six different species. All, in the chrysalis state, possess the thoracic horn and the eight-pointed ventral coronet ; not one benefits by these advantages, which disappear altogether when the adult splits its case. My near neighbourhood numbers a dozen species of Onthophagi ; the world contains some hundreds. All, natives and foreigners, have the same general structure ; all most probably possess the dorsal appendage at an early age ; and none of them, in spite of the variety of the climate, torrid in

one place, moderate in another, has succeeded in hardening it into a permanent horn.

Could the future not complete a work the design of which is so very clearly traced? We ask ourselves this the more readily inasmuch as every appearance encourages the question. Examine under the magnifying-glass the frontal horns of Onthophagus Taurus in the pupa state; then consider as carefully the spear upon the corselet. At first, there is no difference between them, except the general configuration. In both cases, we find the same glassy aspect, the same sheath swollen with a crystalline moisture, the same incipient organ plainly marked. A leg in formation is not more clearly declared than the horn on the corselet or those on the forehead.

Can time be lacking for the thoracic growth to organize itself into a stiff and lasting appendage? The evolution of the nymph is swift; the insect is perfect in a few weeks. Could it not be that, though this brief space suffice to promote the maturity of the horns on the forehead, the thoracic horn requires a longer time to ripen? Let us prolong the nymphal period artificially and give the germ time to develop itself. It seems to me that a decrease of temperature, moderated and maintained for some weeks, for months if necessary, should be capable of bringing about this result, by delaying the progress of the evolution. Then, with a gentle slowness, favourable to delicate formations, the promised organ will crystallize, so to speak, and become the spear heralded by appearances.

The experiment attracted me. I was unable to undertake it for lack of the means whereby to produce a cold, even and lasting temperature. What should I have obtained if my penury had not made me abandon the

enterprise ? A retarding of the progress of the metamorphosis, but nothing more, apparently. The horn on the corselet would have persisted in its sterility and, sooner or later, would have disappeared.

I have reasons for my conviction. The abode of the Onthophagus while engaged on his metamorphosis is not deep down ; variations of temperature are easily felt. On the other hand, the seasons are capricious, especially the spring. Under the skies of Provence, the months of May and June, if the mistral lend a hand, have periods when the thermometer drops in such a way as to suggest a return of winter.

To these vicissitudes let us add the influence of a more northerly climate. The Onthophagi occupy a wide zone of latitude. Those of the north, less favoured by the sun than those of the south, can, if changing circumstances assist at the time of the transformation, undergo long weeks of a decreased temperature which spins out the work of evolution and ought therefore to permit the thoracic armour, at long intervals and casually, to consolidate into a horn. Here and there, then, the conditions of a moderate, or even cold temperature, at the time of the nymphosis, are realized without the aid of my artifices.

Well, what becomes of this surplus time placed at the service of the organic labour ? Does the promised horn ripen ? Not a bit of it : it withers just as it does under the stimulus of a hot sun. The records of entomology have never spoken of an Onthophagus carrying a horn upon his corselet. No one would even have suspected the possibility of such an armour, if I had not rumoured the strange appearance of the nymph. The influence of climate, therefore, goes for nothing here.

Pushed further still, the question becomes more complicated. The horny appendages of the Onthophagus, of the Copris, of Minotaurus and of so many others are the male's prerogative; the female is without them or wears them only on a reduced and very modest scale. We must look upon these corniculate products as personal ornaments much rather than as implements of labour. The male makes himself fine for the pairing; but, with the exception of Minotaurus, who pins down the dry pellet that needs crushing and holds it in position with his trident, I know none that uses his armour as a tool. Horns and prongs on the forehead, crests and crescents on the corselet are jewels of masculine vanity and nothing more. The other sex requires no such baits to attract suitors: its femininity is enough; and finery is neglected.

Now here is something to give us food for thought. The nymph of the Onthophagus of the female sex, a nymph with an unarmed forehead, carries on its thorax a vitreous horn as long, as rich in promise as that of the other sex. If this latter excrescence be an incompletely-realized incipient ornament, then the former would be so too, in which case the two sexes, both anxious for self-embellishment, would work with equal zeal to grow a horn upon their thorax. We should be witnessing the genesis of a species that would not be really an Onthophagus, but a derivative of the group; we should be beholding the commencement of singularities banished hitherto from among the Dung-beetles, none of whom, of either sex, has thought of planting a spear upon his chine. Stranger still: the female, always the more humbly attired throughout the entomological order, would be vying with the male in her propensity for eccentric adornment. An ambition of this sort leaves me incredulous.

We must therefore believe that, if the possibilities of the future should ever produce a Dung-beetle carrying a horn upon his corselet, this upsetter of present customs will not be the Onthophagus succeeding in maturing the thoracic appendage of the nymph, but rather an insect resulting from a new model. The creative power throws aside the old moulds and replaces them by others, fashioned with fresh care, after plans of an inexhaustible variety. Its laboratory is not a peddling rag-fair, where the living assume the cast clothes of the dead : it is a medallist's studio, where each effigy receives the stamp of a special die. Its treasure-house of forms, of unbounded wealth, excludes any niggardly patching of the old to make the new. It breaks up every mould once used ; it does away with it, without resorting to shabby after-touches.

Then what is the meaning of those horny preparations, which are always blighted before they come to aught ? Without feeling greatly abashed by my ignorance, I confess that I am absolutely unable to say. In the absence of an appearance of learning, my answer has at least one merit, that of perfect sincerity.

# A DUNG-BEETLE OF THE PAMPAS

## CHAPTER VIII

### A DUNG-BEETLE OF THE PAMPAS

To travel over the world, by land and sea, from pole to pole; to cross-question life, under every clime, in the infinite variety of its manifestations: that surely would be glorious luck for him that has eyes to see with; and it formed the radiant dream of my young years, at the time when *Robinson Crusoe* was my delight. These rosy illusions, rich in voyages, were soon succeeded by dull, stay-at-home reality. The jungles of India, the virgin forests of Brazil, the towering crests of the Andes, beloved by the condor, were reduced, as a field for exploration, to a patch of pebble-stones enclosed within four walls.

Heaven forfend that I should complain! The gathering of ideas does not necessarily imply distant expeditions. Jean-Jacques Rousseau herborized with the bunch of chickweed whereon he fed his canary; Bernardin de Saint-Pierre discovered a world on a strawberry-plant that grew by accident in a corner of his window; Xavier de Maistre, using an arm-chair by way of post-chaise, made one of the most famous of journeys around his room.[1]

This manner of seeing country is within my means, always excepting the post-chaise, which is too difficult to drive through the brambles. I go the circuit of my

[1] *Voyage autour de ma chambre* (1795).—*Translator's Note.*

enclosure over and over again, a hundred times, by short stages; I stop here and I stop there; patiently, I put questions; and, at long intervals, I receive some scrap of a reply.

The smallest insect village has become familiar to me: I know each fruit-branch where the Praying Mantis perches; each bush where the pale Italian Cricket strums amid the calmness of the summer nights; each wad-clad blade of grass scraped by the Anthidium, that maker of cotton bags; each cluster of lilac worked by the Megachile, the leaf-cutter.

If cruising among the nooks and corners of the garden do not suffice, a longer voyage shows ample profit. I double the cape of the neighbouring hedges and, at a few hundred yards, enter into relations with the Sacred Beetle, the Capricorn, the Geotrupe, the Copris, the Dectus, the Cricket, the Green Grasshopper, in short, with a host of tribes the unfolding of whose story would exhaust a human life. Certainly, I have plenty, I have too much to do with my near neighbours, without going and wandering in distant regions.

And then, besides, roaming the world, scattering one's attention over a host of subjects, is not observing. The travelling entomologist can stick numerous species, the joy of the collector and the nomenclator, into his boxes; but to gather circumstantial documents is a very different matter. A Wandering Jew of science, he has no time to stop. Where a prolonged stay would be necessary to study this or that fact, he is hurried by the next stage. We must not expect the impossible of him in these conditions. Let him pin his specimens to cork tablets, let him steep them in tafia jars and leave to the sedentary the patient observations that require time.

This explains the extreme penury of history outside the dry descriptions of the nomenclator. Overwhelming us with its numbers, the exotic insect nearly always preserves the secret of its manners. Nevertheless, it were well to compare what happens under our eyes with that which happens elsewhere ; it were excellent to see how, in the same corporation of workers, the fundamental instinct varies with climatic conditions.

Then my travelling regrets return, vainer to-day than ever, unless one could find a seat on the carpet of which we read in the *Arabian Nights*, the famous carpet whereon one had but to sit to be carried whithersoever he pleased. O marvellous conveyance, far preferable to Xavier de Maistre's post-chaise ! If only I could find a little corner on it, with a return-ticket !

I do find it. I owe this unexpected good fortune to a Christian Brother, to Brother Judulian, of the Lasalle College at Buenos Ayres. His modesty would be offended by the praises which his debtor owes him. Let us simply say that, acting on my instructions, his eyes take the place of mine. He seeks, finds, observes, sends me his notes and his discoveries. I observe, seek and find with him, by correspondence.

It is done : thanks to this first-rate collaborator, I have my seat on the magic carpet. Behold me in the pampas of the Argentine Republic, eager to draw a parallel between the industry of the Dung-beetles of Sérignan[1] and that of their rivals in the western hemisphere.

A glorious beginning ! An accidental find procures me, to start with, Phanæus Milo, a magnificent insect, blue-black all over. The corselet of the male juts forward, over the head, in a short, broad, flattened

[1] Sérignan, in Provence, is the author's birth-place.—*Translator's Note.*

horn, ending in a trident. The female replaces this ornament with simple folds. Both carry, in front of their shield, two spikes which form a trusty digging-implement and also a scalpel for dissecting. The insect's squat, sturdy, four-cornered build resembles that of Onitis Olivieri, one of the rarities of the neighbourhood of Montpellier.

If similarity of shape implied parity of work, we ought unhesitatingly to attribute to Phanæus Milo short, thick puddings like those made by Olivier's Onitis. Alas, structure is a bad guide where the instinct is concerned! The square-chined, short-legged Dung-worker excels in the art of manufacturing gourds. The Sacred Beetle himself supplies none that are more perfect nor, above all, more capacious.

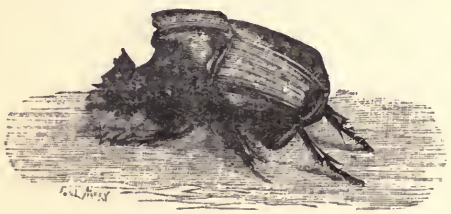


FIG. 8.—Phanæus Milo.

The thick-set insect astonishes me with the elegance of its work, which is irreproachable in its geometry: the neck is less slender, but nevertheless combines grace with strength. The model seems derived from some Indian calabash, the more so as the neck opens wide and the belly is engraved with an elegant guilloche, produced by the insect's tarsi. One seems to see a pitcher protected by a wicker-work covering. The whole is able to attain and even exceed the size of a hen's egg.

It is a very curious piece of work and of a rare perfection, especially when we consider the artist's clumsy and massive build. Once again, the tool does not make the

workman, among Dung-beetles any more than among ourselves. To guide the modeller there is something better than a set of tools : there is what I would call the bump, the genius of the animal.

Phanæus Milo laughs at difficulties. He does more : he laughs at our classifications. The word Dung-beetle implies a lover of dung. He sets no value on it, either for his own use or for that of his offspring. What he wants is the sanies of corpses. He is to be found under the carcasses of birds, dogs or cats, in the company of the undertakers-in-ordinary. The gourd of which I give a drawing overleaf was lying in the earth under the remains of an owl.

Let him who will explain this conjunction of the appetites of the Necrophore with the talents of the Scarab. As for me, baffled by tastes which no one would suspect from the mere appearance of the insect, I give it up.

I know in my neighbourhood one Dung-beetle and one alone who also works among the remains of dead bodies. This is Onthophagus Ovatus (Lin.), a constant frequenter of dead moles and rabbits. But the dwarf undertaker does not on that account scorn stercoraceous fare : he feasts upon it like the other Onthophagi. Perhaps there is a two-fold diet here : the bun for the adult ; the highly-spiced, far-gone meat for the grub.

Similar facts are encountered elsewhere with different tastes. The predatory Hymenopteron takes her fill of honey drawn from the nectaries of the flowers, but feeds her little ones on game. Game first, then sugar, for the same stomach. How that digestive pouch must change on the road ! And yet no more than our own, which scorns in later life that which delighted it when young.

Let us now examine the work of Phanæus Milo

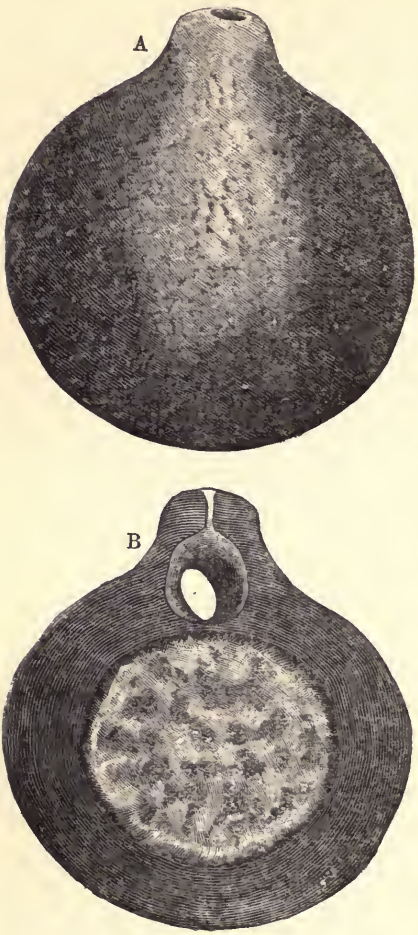



FIG. 9.—Work of Phanæus Milo.

A, the whole piece, actual size. B, the same opened, showing the pill of sausage-meat, the clay gourd, the chamber containing the egg and the ventilating-shaft.

more thoroughly. The calabashes came into my hands in a state of complete desiccation. They are very nearly as hard as stone; their colour favours a pale chocolate. Neither inside nor out does the lens discover the small fibrous particle pointing to a residuum of grasses. The strange Dung-beetle does not, therefore, employ the bovine cakes, nor anything similar; he handles products of another class, which are pretty difficult to specify at first.

Held to the ear and shaken, the object sounds a little as would the shell of a dry fruit with a stone lying free inside it. Does it contain the grub, shrivelled by desiccation? Does it contain the dead insect? I thought so,

but I was wrong. It contains something much better than that for our instruction.

I carefully rip up the gourd with the point of the knife. Under a homogeneous outer wall, the thickness of which reaches as much as two centimetres[1] in the largest of my three specimens, is encased a spherical kernel, which fills the cavity exactly, but without sticking to the wall at any part. The trifle of free scope allowed to this kernel accounts for the rattling which I heard when shaking the piece.

The kernel does not differ from the wrapper in the colour and general appearance of its bulk. But let us break it and examine the shreds. I recognize tiny fragments of gold, flocks of down, threads of wool, scraps of meat, the whole drowned in an earthy paste resembling chocolate.

Placed on a glowing coal, this paste, shredded under the lens and deprived of its particles of dead bodies, becomes much darker, is covered with shiny bubbles and sends forth puffs of that acrid smoke in which we easily recognize burnt animal matter. The whole mass of the kernel, therefore, is strongly impregnated with sanies.

Treated in the same manner, the wrapper also turns dark, but not to the same extent; it hardly smokes; it is not covered with jet-black bubbles; lastly, it does not anywhere contain shreds of carcasses similar to those in the central nut. In both cases, the residuum of the calcination is a fine, reddish clay.

This brief analysis tells us all about Phanæus Milo's table. The fare served to the grub is a sort of *vol-au-vent*. The sausage-meat consists of a mince of all that the two scalpels of the shield and the toothed knives of the fore-legs have been able to cut away from the carcass:

[1] ·78 inch.—*Translator's Note.*

hair and down, crushed ossicles, strips of flesh and skin. Now hard as brick, the thickening of that mince was originally a jelly of fine clay soaked in the juice of corruption. Lastly, the puff-paste crust of our *vol-au-vent* is here represented by a covering of the same clay, less rich in extract of meat than the other.

The pastry-cook gives his pie an elegant shape; he decorates it with rosettes, with twists, with scrolls. Phanæus Milo is no stranger to these culinary æsthetics. He turns the crust of his *vol-au-vent* into a handsome gourd, ornamented with a finger-print guilloche.

The outer covering, a disagreeable crust, insufficiently steeped in savoury juices, is not, we can easily guess, intended for consumption. It is possible that, somewhat later, when the stomach becomes robust and is not repelled by coarse fare, the grub scrapes a little from the wall of its pie; but, taken as a whole, until the adult insect emerges, the calabash remains intact, having acted as a safeguard of the freshness of the mince-meat at first and as a protecting box for the recluse from start to finish.

Above the cold pasty, right at the base of the neck of the gourd, is contrived a round cell with a clay wall continuing the general wall. A fairly thick floor, made of the same material, separates it from the store-room. It is the hatching-chamber. Here is laid the egg, which I find in its place, but dried up; here is hatched the worm, which, to reach the nourishing ball, must previously open a trap-door through the partition separating the two storeys.

The worm is born in a little box surmounting the nourishing pile, but not communicating with it. The budding grub must, therefore, at the opportune moment, itself pierce the covering of the pot of preserves. As a

matter of fact, later, when the worm is on the sausage-meat, we find the floor perforated with a hole just large enough for it to pass through.

Wrapped all round in a thick casing of pottery, the meat keeps fresh as long as is required by the duration of the hatching-process, a detail which I have not ascertained; in its cell, which is also of clay, the egg lies safe. Capital: so far, all is well. Phanæus Milo is thoroughly acquainted with the mysteries of fortification and the danger of victuals evaporating too soon. There remain the breathing requirements of the germ.

To satisfy these, the insect has been equally well-inspired. The neck of the calabash is pierced, in the direction of its axis, with a tiny channel which would admit at most the thinnest of straws. Inside, this conduit opens at the top of the dome of the hatching-chamber; outside, at the tip of the nipple, it spreads into a wide mouth-piece. This is the ventilating-shaft, protected against intruders by its extreme narrowness and by grains of dust which obstruct it a little, without stopping it up. It is simply marvellous, I said. Was I wrong? If a construction of this sort is a fortuitous result, we must admit that blind chance is gifted with extraordinary foresight.

How does the awkward insect manage to carry so delicate and complex a piece of building through? Exploring the pampas as I do through the eyes of an intermediary, my only guide in this question is the structure of the work, a structure whence we can deduct the workman's methods without going far wrong. I therefore imagine the labour to proceed like this: a small carcass is found, the oozing of which has softened the underlying loam. The insect collects more or less of this loam,

according to the richness of the vein. There are no precise limits here. If the plastic material abound, the collector is lavish with it and the provision-box becomes all the more solid. Then enormous calabashes are obtained, exceeding a hen's egg in volume and formed of an outer wall a couple of centimetres thick.[1] But a mass of this description is beyond the strength of the modeller, is badly handled and betrays, in its outline, the clumsiness of an over-difficult task. If the material be rare, the insect confines its harvesting to what is strictly necessary; and then, freer in its movements, it obtains a magnificently regular gourd.

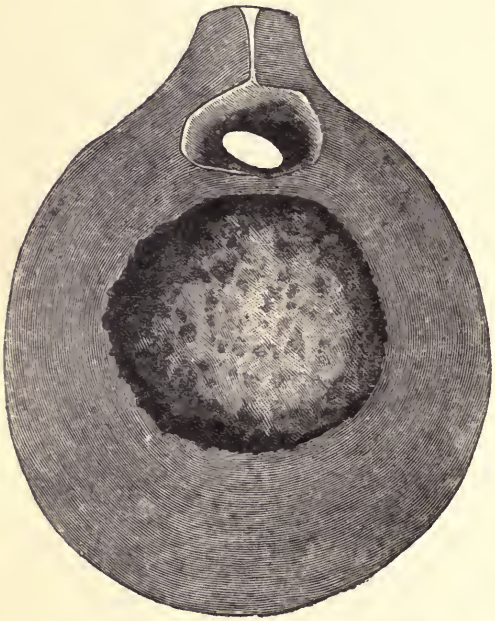


FIG. 10.—Work of Phanæus Milo: the largest of the gourds observed (natural size).

The loam is probably first kneaded into a ball and then scooped out into a large and very thick cup, by means of the pressure of the fore-legs and the work of the shield.

[1] ·78 inch.—*Translator's Note.*

Even thus do the Copris and the Sacred Beetle act when preparing, on the top of their round ball, the bowl in which the egg will be laid before the final manipulation of the ovoid or pear.

In this first business, Phanæus is simply a potter. So long as it be plastic, any clay serves his turn, however meagrely it be saturated with the juices emanating from the carcass.

He now becomes a pork-butcher. With his toothed knife, he carves, he saws some tiny shreds from the rotten animal; he tears off, cuts away what he deems best suited to the grub's entertainment. He collects all these fragments and mixes them with choice loam in the spots where the sanies abounds. The whole, cunningly kneaded and softened, becomes a ball obtained on the spot, without any rolling process, in the same way as the globe of the other pill-manufacturers. Let us add that this ball, a ration calculated by the needs of the grub, is very nearly constant in size, whatever the thickness of the final calabash. The sausage-meat is now ready. It is set in place in the wide-open clay bowl. Loosely packed, without compression, the food will remain free, will not stick to its wrapper.

Next, the potter's work is renewed. The insect presses the thick lips of the clayey cup, rolls them out and applies them to the forcemeat preparation, which is eventually contained by a thin partition at the top and by a thick layer every elsewhere. A large circular pad is left on the top partition, which is slender in view of the weakness of the grub that is to perforate it later, when making for the provisions. Manipulated in its turn, this pad is converted into a hemispherical hollow, in which the egg is forthwith laid.

The work is finished by rolling out and joining the edges of the little crater, which closes and becomes the hatching-chamber. Here, especially, a delicate dexterity becomes essential. At the time that the nipple of the calabash is being shaped, the insect, while packing the material, must leave the little channel which is to form the ventilating-shaft, following the line of the axis. This narrow conduit, which an ill-calculated pressure might stop up beyond hope of remedy, seems to me extremely difficult to obtain. The most skilful of our potters could not manage it without the aid of a needle, which he would afterwards withdraw. The insect, a sort of jointed automaton, obtains its channel through the massive nipple of the gourd without so much as a thought. If it did give it a thought, it would not succeed.

The calabash is made : there remains the decoration. This is the work of patient after-touches which perfect the curves and leave on the soft loam a series of stippled impressions similar to those which the potter of prehistoric days distributed with the end of his thumb over his big-bellied jars.

That ends the work. The insect will begin all over again under a fresh carcass ; for each burrow has one calabash and no more, even as with the Sacred Beetle and her pears.

# THE GEOTRUPES

## CHAPTER IX

### THE GEOTRUPES : THE PUBLIC HEALTH

To complete the cycle of the year in the full-grown form, to see one's self surrounded by one's sons at the spring festivals, to double and treble one's family : that surely is a most exceptional privilege in the insect world. The Apids, the aristocracy of instinct, perish, once the honey-pot is filled ; the Butterflies, the aristocracy not of instinct, but of dress, die when they have fastened their packet of eggs in a propitious spot ; the Carabids, richly cuirassed, succumb when the germs of a posterity are scattered beneath the stones.

So with the others, except among the gregarious insects, where the mother survives, either alone or accompanied by her attendants. It is a general law : the insect is born orphaned of both its parents. Now, by an unexpected turn of fate, the humble scavenger escapes the stern destiny that cuts down the proud. The Dung-beetle, sated with days, becomes a patriarch and really deserves to do so, in consideration of the services rendered.

There is a general hygiene that calls for the disappearance, in the shortest possible time, of every putrid thing. Paris has not yet solved the formidable problem of her refuse, which sooner or later will become a question of life or death for the monstrous city. One asks one's self whether the centre of light be not doomed to be extin-

guished one day in the reeking exhalations of a soil saturated with rottenness. What this agglomeration of millions of men cannot obtain, with all its treasures of wealth and talent, the smallest hamlet possesses without going to any expense or even troubling to think about it.

Nature, so lavish of her cares in respect of rural health, is indifferent to the welfare of cities, if not actively hostile to it. She has created for the fields two classes of scavengers, whom nothing wearies, whom nothing repels. One of these—consisting of Flies, Silphids, Dermestes, Necrophores—is charged with the dissection of corpses. They cut and hash, they elaborate the waste matter of death in their stomachs in order to restore it to life.

A mole ripped open by the plough-share soils the path with its entrails, which soon turn purple ; a snake lies on the grass, crushed by the foot of a wayfarer who thought, the fool, that he was performing a good work ; an unfledged bird, fallen from its nest, has flattened itself piteously at the foot of the tree that carried it ; thousands of other similar remains, of every sort and kind, are scattered here and there, threatening danger through their effluvia, if nothing come to establish order. Have no fear : no sooner is a corpse signalled in any direction than the little undertakers come trotting along. They work away at it, empty it, consume it to the bone, or at least reduce it to the dryness of a mummy. In less than twenty-four hours, mole, snake, bird have disappeared and the requirements of health are satisfied.

The same zeal for their task prevails in the second class of scavengers. The village hardly knows those ammonia-scented refuges whither we repair, in the towns, to relieve our wretched needs. A little wall no higher than that, a hedge, a bush is all that the peasant asks

as a retreat at the moment when he would fain be alone. I need say no more to suggest the encounters to which such free and easy manners expose you! Enticed by the patches of lichen, the cushions of moss, the tufts of homewort and other pretty things that adorn old stones, you go up to a sort of wall that supports the ground of a vineyard. Ugh! At the foot of the daintily-decked shelter, what a spreading abomination! You flee: lichens, mosses and homewort tempt you no more. But come back on the morrow. The thing has disappeared, the place is clean: the Dung-beetles have been that way.

To preserve the eyes from offensive sights too oft repeated is, to those gallant fellows, the least of offices: a loftier mission is incumbent on them. Science tells us that the most dreadful scourges of mankind have their agents in tiny organisms, the microbes, near neighbours of must and mould, on the extreme confines of the vegetable kingdom. The terrible germs multiply by countless myriads in the intestinal discharges at times of epidemic. They contaminate the air and water, those primary necessities of life; they spread over our linen, our clothes, our food and thus diffuse contagion. We have to destroy by fire, to sterilize with corrosives or to bury underground such things as are soiled with them.

Prudence even demands that we should never allow ordure to linger on the surface of the ground. It may be harmless, it may be dangerous: when in doubt, the best thing is to put it out of sight. That is how ancient wisdom seems to have understood the thing, long before the microbe explained to us the great need for vigilance. The nations of the East, more exposed to epidemics than ourselves, had formal laws in these matters. Moses, apparently echoing Egyptian knowledge in this connec-

tion, prescribed the line of conduct for his people wandering in the Arabian desert :

" Thou shalt have a place without the camp," he says, " to which thou mayst go for the necessities of nature, carrying a paddle at thy girdle. And, when thou sittest down, thou shalt dig round about and, with the earth that is dug up, thou shalt cover that which thou art eased of." (Deut., XXIII., xii-xiv.)

This is a precept of grave import in its simplicity. And we may well believe that, if Islamism, at the time of its great pilgrimages to the Kaaba, were to take the same precaution and a few more of a similar character, Mecca would cease to be an annual seat of cholera and Europe would not need to mount guard on the shores of the Red Sea to protect herself against the scourge.

Heedless of hygiene as the Arab, who was one of his ancestors, the Provençal peasant does not suspect the danger. Fortunately, the Dung-beetle, that faithful observer of the Mosaic edict, works. It is his to remove from sight, it is his to bury the germ-crammed matter.

Supplied with implements for digging far superior to the paddle which the Israelite was to carry at his girdle when urgent business called him from the camp, he hastens and, as soon as man is gone, digs a pit wherein the infection is swallowed up and rendered harmless.

The services rendered by these diggers are of the highest importance to the health of the fields ; yet we, who are mainly interested in this constant work of purification, hardly vouchsafe those sturdy fellows a contemptuous glance. Popular language overwhelms them with obnoxious epithets. This appears to be the

rule : do good and you shall be misjudged, you shall be traduced, stoned, trodden underfoot, as witness the toad, the bat, the hedgehog, the owl and other auxiliaries who, to serve us, ask nothing but a little tolerance.

Now, of our defenders against the dangers of filth spread shamelessly in the rays of the sun, the most remarkable, in our climes, are the Geotrupes : not that they are more zealous than the others, but because their size makes them capable of bigger work. Moreover, when it becomes simply a question of their nourishment, they resort by preference to the materials which we have most to fear.

My neighbourhood is worked by four Geotrupes. Two of them, Geotrupes Mutator (Marsh) and Geotrupes Sylvaticus (Panz.), are rarities on which we had best not count for connected studies ; the two others, on the contrary, Geotrupes Stercorarius (Lin.) and Geotrupes Hypocrita (Schneid.), are exceedingly frequent. Black as ink above, both of them are magnificently garbed below. One is quite surprised to find such a jewel-case among the professional scavengers. Geotrupes Stercorarius is of a splendid amethyst violet on his lower surface, while Geotrupes Hypocrita is lavish with the ruddy gleams of copper pyrites. These are the two inmates of my voleries.

Let us ask them first of what feats they are capable as buriers. There are a dozen, of the two species taken together. The cage is previously swept clean of what remains of the former provisions, hitherto supplied without stint. This time, I propose to arrive at what a Geotrupe can put away at a sitting. At sunset, I serve to my twelve captives the whole of a heap which a mule has just dropped in front of my door. There is plenty of it, enough to fill a basket.

On the morning of the next day, the mass has disappeared underground. There is nothing left outside, or very nearly nothing. I am able to make a fairly close estimate and I find that each of my Geotrupes, presuming each of the twelve to have done an equal share of the work, has stowed away very nearly a cubic decimetre[1] of matter. A Titanic task, if we remember the insignificant size of the animal, which, moreover, has to dig the warehouse to which the booty must be lowered. And all this is done in the space of a night.

So well provided, will they remain quietly underground with their treasure? Not they! The weather is magnificent. The hour of twilight comes, gentle and calm. This is the time of the great flights, the mirthful hummings, the distant explorations on the roads by which the herds have lately passed. My lodgers abandon their cellars and mount to the surface. I hear them buzzing, climbing up the wirework, knocking themselves wildly against the walls. I have anticipated this twilight animation. Provisions have been collected during the day, plentiful as those of yesterday. I serve them. There is the same disappearance during the night. On the morrow, the place is once again swept clean. And this would continue indefinitely, so fine are the evenings, if I always had at my disposal the wherewithal to satisfy those insatiable hoarders.

Rich though his booty be, the Geotrupe leaves it at sunset to sport in the last gleams of daylight and to go in search of a new workplace. With him, one would say, the wealth acquired does not count; the only valid thing is that to be acquired. Then what does he do with his warehouses, renewed, in favourable times, at

[1] About 61 cubic inches.—*Translator's Note.*

each new twilight? It is obvious that Stercorarius is incapable of consuming provisions so plentiful in a single night. He has such a superabundance of victuals in his larder that he does not know how to dispose of them; he is surfeited with good things by which he will not profit; and, not satisfied with having his store crammed, the acquisitive plutocrat slaves, night after night, to store away more.

From each warehouse, set up here, set up there, as things happen, he deducts the daily meal beforehand; the rest, that is to say, almost the whole, he abandons. My voleries testify to the fact that this instinct for burying is more exacting than the consumer's appetite. The ground is soon raised, in consequence; and I am obliged, from time to time, to lower the level to the desired limits. If I dig it up, I find it choked, throughout its depth, with hoards that have remained intact. The original earth has become an inextricable conglomerate, which I must prune with a free hand, if I would not go astray in my future observations.

Allowing for errors, either of excess or deficiency, which are inevitable in a subject that does not admit of precise gauging, one point stands out very clearly from my enquiry: the Geotrupes are passionate buriers; they take underground a deal more than is necessary for their consumption. As this work is performed, in varying degrees, by legions of collaborators, large and small, it is evident that the purification of the soil must benefit by it to an ample extent and that the public health is to be congratulated on having this army of auxiliaries in its service.

In other respects, the plant and, indirectly, a host of different existences are interested in these interments. What the Geotrupe buries and abandons the next day

is not lost: far from it. Nothing is lost in the world's balance-sheet; the stock-taking total is constant. The little lump of dung buried by the insect will make the nearest tuft of grass grow a luxuriant green. A sheep passes, crops the bunch of grass: all the better for the leg of mutton which man is waiting for. The Dung-beetle's industry has procured us a savoury mouthful.

In September and October, when the first autumn rains soak the ground and allow the Sacred Beetle to split his natal casket, Geotrupes Stercorarius and Geotrupes Hypocrita found their family-establishments, somewhat makeshift establishments, in spite of what we might have expected from the name of those miners, so well-styled Geotrupes, that is to say, "Earth-borers." When he has to dig himself a retreat that shall shelter him against the rigours of winter, the Geotrupe really deserves his name: none can compare with him for the depth of the pit or the perfection and rapidity of the work. In sandy ground, easily excavated, I have dug up some that had attained the depth of a metre.[1] Others carried their digging further still, tiring both my patience and my implements. There you have the skilled well-sinker, the incomparable Earth-borer. When the cold sets in, he can go down to some layer where frost has lost its terrors.

The lodging of the family is another matter. The propitious season is a short one; time would fail, if each individual grub had to be endowed with one of those manor-houses. That the insect should devote the leisure which the approach of winter gives it to digging a hole of unlimited depth is a capital thing: it makes the retreat doubly safe; and activity, not yet quite sus-

[1] Over 39 inches.—*Translator's Note.*

FIG. 11.—The Stercoraceous Geotrupe's sausage.

pended, has for the moment no other occupation. But, at laying-time, these laborious undertakings are impossible. The hours pass swiftly. In four or five weeks, a pretty numerous family has to be housed and victualled, which puts a long, patiently-sunk pit entirely out of the question.

The burrow dug by the Geotrupe for the benefit of her grub is hardly deeper than that of the Copris or the Sacred Beetle, notwithstanding the difference of the seasons. Three decimetres,[1] roughly speaking: that is all that I find in the fields, where nothing occurs to limit the depth.

Fig. 12.—Section of the Stercoraceous Geotrupe's sausage at its lower end, showing the egg and the hatching-chamber.

The contents of the rustic dwelling take the form of a sort of sausage or pudding, which fills the lower part of the cylinder and fits it exactly. Its length is not far short of a couple of decimetres.[2] This sausage is almost always irregular in shape, now curved, now more or less dented. These imperfections of the surface are due to the accidents of a stony ground, which the insect does not always excavate according to the canons of its art, which favours the straight line and the perpendicular. The moulded material faithfully reproduces all the irregularities of its

[1] 11 to 12 inches.—*Translator's Note.*
[2] 7½ to 8 inches.—*Translator's Note.*

mould. The lower extremity is rounded off like the bottom of the burrow itself; at the lower end of the sausage is the hatching-chamber, a round cavity which could hold a fair-sized hazel-nut. The respiratory needs of the germ demand that the side-walls should be thin enough to allow easy access to the air. Inside, I catch the gleam of a greenish, semi-fluid plaster, a dainty which the mother has disgorged to form the first mouthfuls of the budding worm.

In this round hole lies the egg, without adhering in any way to the surrounding walls. It is a white, elongated ellipsoid and is of remarkable bulk in proportion to the insect. In the case of Geotrupes Stercorarius, it measures seven to eight millimetres in length by four in its greatest width.[1] The egg of Geotrupes Hypocrita is a little smaller.

[1] ·27 to ·31 × ·15 inch.—*Translator's Note.*

MINOTAURUS TYPHŒUS

## CHAPTER X

### MINOTAURUS TYPHŒUS

To describe the insect that forms the subject of this chapter, scientific nomenclature joins two formidable names : that of the Minotaur, Minos' bull fed on human flesh in the crypts of the Cretan labyrinth ; and that of Typhœus, one of the giants, sons of Terra, who tried to scale the heavens. Thanks to the clue of thread which he received from Minos' daughter Ariadne, Theseus the Athenian found the Minotaur, slew him and made his escape, safe and sound, after delivering his country for ever from the dreadful tribute destined for the monster's food.

Typhœus, struck by a thunderbolt on his heaped-up mountains, was hurled under Mount Etna. He is there still. His breath is the smoke of the volcano. When he coughs, he spits out streams of lava ; when he shifts his position from one shoulder to the other, he puts Sicily aflutter ; he shakes her with an earthquake.

It is not unpleasant to find an echo of these old fables in the history of animals. Mythological denominations, so resonant and pleasing to the ear, entail no inconsistencies with reality, a fault that is not always avoided by the terms compiled wholly of *data* gathered from the lexicon. When vague analogies, in addition, connect the fabled with the historical, then surnames and fore-

names both become very happy. Such is the case with Minotaurus Typhœus (Lin.).

It is the name given to a fair-sized black coleopteron, closely related to the Earth-borers, the Geotrupes. He is a peaceable, inoffensive creature, but even better-horned than Minos' bull. None among our harness-loving insects wears so threatening an armour. The male carries on his corselet a sheaf consisting of three steeled spears, parallel to one another and jutting forward. Imagine him the size of a bull; and Theseus himself, if he met him in the fields, would hardly dare to face his terrible trident.

The Typhœus of the legend had the ambition to sack the home of the gods by stacking one upon the other a pile of mountains torn from their base; the Typhœus of the naturalists does not climb: he descends; he bores the ground to enormous depths. The first, with a movement of the shoulder, sets a province heaving; the second, with a thrust of its chine, makes his mole-hill tremble as Etna trembles when he stirs who lies buried within her depths.

Such is the insect wherewith we are concerned.

But what is the use of this history, what the use of all this minute research? I well know that it will not produce a fall in the price of pepper, a rise in that of crates of rotten cabbages, or other serious events of this kind, which cause fleets to be manned and set people face to face intent upon one another's extermination. The insect does not aim at so much glory. It confines itself to showing us life in the inexhaustible variety of its manifestations; it helps us to decipher in some small measure the obscurest book of all, the book of ourselves.

The insect is easy to obtain, cheap to feed and not repulsive to examine organically; and it lends itself far

better than the higher animals to the investigations of our curiosity. Besides, the others are our near neighbours and do but repeat a somewhat monotonous theme, whereas the insect, with its unparalleled wealth of instincts, habits and structure, reveals a new world to us, much as though we were conferring with the natives of another planet. This is the reason that makes me constantly renew my unwearied relations with the insect and hold it in such high esteem.

Minotaurus Typhœus favours the open sandy places where, on their way to the grazing-ground, the flocks of sheep scatter their trails of black pellets which constitute his regulation fare. Couples jointly addicted to nest-building begin to meet in the first days of March. The two sexes, until then isolated in surface-burrows, are now associated for a long time to come.

Do the husband and wife recognize each other among their fellows ? Are they mutually faithful ? Cases of breach of matrimony are very rare, in fact unknown, on the part of the mother, who has long ceased to leave the house ; on the other hand, they are frequent on the part of the father, whose duties often oblige him to come outside. As will be seen presently, he is, throughout his life, the purveyor of victuals and the person entrusted with the carriage of the rubbish. Alone, at different hours of the day, he flings out of doors the earth thrown up by the mother's excavations ; alone he explores the vicinity of the home at night, in quest of the pellets whereof his sons' loaves shall be kneaded.

Sometimes, two burrows are side by side. Cannot the collector of provisions, on returning home, easily mistake the door and enter another's house ? On his walks abroad, does he never happen to meet ladies taking the

air who have not yet settled down ; and is he, then, not forgetful of his first mate and ready for divorce ? The question deserved to be examined. I tried to solve it in the manner that follows.

Two couples are taken from the ground at a time when the excavations are in full swing. Indelible marks, contrived with the point of a needle on the lower edge of the elytra, will enable me to distinguish them one from the other. The four subjects of my experiment are distributed at random, one by one, over the surface of a sandy area a couple of spans thick. A soil of this depth will be sufficient for the excavations of a night. In case provisions should be needed, a handful of sheep-droppings is served. A large reversed earthen pan covers the arena, prevents escape and produces the darkness favourable to mental concentration.

The next morning provides a splendid response. There are two burrows in the establishment, no more ; the couples have formed again as they were : each Jack has his Jill. A second experiment, made next day, and a third meet with the same success : those marked with a point are together, those not marked are together, at the bottom of the gallery.

Five times more, day after day, I make them set up house anew. Things now begin to be spoilt. Sometimes, each of the four that are being experimented on settles apart ; sometimes, the same burrow contains the two males or the two females ; sometimes, the same crypt receives the two sexes, but differently associated from what they were at the start. I have abused my powers of repetition. Henceforth disorder reigns. My daily shufflings have demoralized the burrowers ; a crumbling nome, always requiring to be begun afresh, has put an

end to lawful associations. Respectable married life becomes impossible from the moment when the house falls in from day to day.

No matter: the first three experiments, made when alarms, time after time repeated, had not yet tangled the delicate connecting thread, seem to point to a certain constancy in the Minotaurus household. He and she know each other, find each other in the tumult of events which my mischievous doings force upon them; they show each other a mutual fidelity, a very unusual quality in the insect class, which is but too prone to forget its matrimonial obligations.

We recognize one another by our speech, by the sound, the inflection of our voices. They, on the other hand, are dumb, deprived of all means of vocal appeal. There remains the sense of smell. Minotaurus finding his mate makes me think of my friend Tom, the house-dog, who, at his moony periods, lifts his nose in the air, sniffs the breeze and jumps over the garden-walls, eager to obey the distant and magical convocation; he puts me in mind of the Great Peacock Moth, who swiftly covers several miles to pay his homage to the new-hatched maid.

The comparison, however, is far from perfect. The dog and the big Moth get wind of the wedding before they know the bride. Minotaurus, on the other hand, has no experience of long pilgrimages, yet makes his way, in a brief circuit, to her whom he has already visited; he knows her, he distinguishes her from the others by certain emanations, certain individual scents inappreciable to any save the enamoured swain. Of what do these effluvia consist? The insect did not tell me; and that is a pity, for it would have taught us things worth knowing about its feats of smell.

Now how is the work divided in this household ? To discover this is not one of those easy undertakings for which the point of a knife suffices. He who proposes to visit the burrowing insect at home must have recourse to arduous sapping. We have here to do not with the apartment of the Sacred Beetle, the Copris or the others, which is soon laid bare with a mere pocket-trowel: we have to do with a pit the bottom of which can be reached only with a stout spade, sturdily wielded for hours at a stretch. And, if the sun be at all hot, one returns from the drudgery utterly exhausted.

Oh, my poor joints, grown rusty with age ! To suspect the existence of a fine problem underground and not to be able to dig ! The zeal survives, as ardent as in the days when I used to pull down the spongy slopes beloved by the Anthophora ; the love of research has not abated, but the strength is lacking. Luckily, I have an assistant, in the shape of my son Paul, who lends me the vigour of his wrists and the suppleness of his loins. I am the head, he is the arm.

The rest of the family, including the mother—and she not the least eager—usually go with us. One cannot have too many eyes when the pit becomes deep and one has to observe from a distance the minute documents exhumed by the spade. What the one misses the other perceives. Huber,[1] when he went blind, studied the bee through the intermediary of a clear-sighted and devoted adjutrix. I am even better-off than the great Swiss naturalist. My sight, which is still fairly good, although exceedingly tired, is aided by the deep-seeing eyes of all

[1] François Huber (1750–1831), the Swiss naturalist. He early became blind from excessive study and conducted his scientific work thereafter with the aid of his wife.—*Translator's Note.*

*Minotaurus Typhœus*, male and female.
Excavating Minotaurus' burrow.

my family. I owe to them the fact that I am able to pursue my researches : let me thank them here.

We are on the spot early in the morning. We soon find a burrow with a large mole-hill formed of cylindrical stoppers forced out in one lump by blows of the rammer. We clear away the mound and a pit of great depth opens below it. A useful reed, gathered on the way, serves me as a guide, diving lower and lower down. At last, at about five feet, the reed touches bottom. We are there, we have reached Minotaurus' chamber.

The pocket-trowel prudently lays things bare and we see the occupants appear : the male first and, a little lower, the female. When the couple are removed, a dark, circular patch shows : this is the end of the column of victuals. Careful now and let us dig gently ! What we have to do is to cut away the central clod at the bottom of the vat, to isolate it from the surrounding earth and then, slipping the trowel underneath and using it as a lever, to extract the block all in a lump. There ! That's done it ! We possess the couple and their nest. A morning of arduous digging has procured us those treasures : Paul's steaming back could tell us at the price of what efforts.

This depth of five feet is not and could not be constant ; numbers of causes induce it to vary, such as the degree of freshness and consistency of the soil traversed, the insect's passion for work and the time available, according to the more or less remote date of the laying. I have seen burrows go a little lower ; I have seen others reach barely three feet. In any case, Minotaurus, to settle his family, requires a lodging of exaggerated depth, such as is dug by no other burrowing insect of my acquaintance. Presently we shall have to ask ourselves what are the

imperious needs that oblige the collector of sheep-droppings to reside so low down in the earth.

Before leaving the spot, let us note a fact the evidence of which will be of value later. The female was right at the bottom of the burrow ; above her, at some distance, was the male : both were struck motionless with fright in the midst of an occupation the nature whereof we are not yet able to specify. This detail, observed repeatedly in the different burrows excavated, seems to show that each of the two fellow-workers has a fixed place.

The mother, more skilled in nursery matters, occupies the lower floor. She alone digs, versed as she is in the properties of the perpendicular, which economizes work while giving the greatest depth. She is the engineer, always in touch with the working-face of the gallery. The other is her journeyman-mason. He is stationed at the back, ready to load the rubbish on his horny hod. Later, the excavatrix becomes a baker : she kneads the cakes for the children into cylinders ; the father is then her baker's boy. He fetches her from outside the wherewithal for making flour. As in every well-regulated household, the mother is minister of the interior, the father minister of the exterior. This would explain their invariable position in the tubular home. The future will tell us if these conjectures represent the reality as it is.

For the moment, let us make ourselves at home and examine at leisure the central clod so laboriously acquired. It contains preserved foodstuffs in the shape of a sausage nearly as long and thick as one's finger. This is composed of a dark, compact matter, arranged in layers, which we recognize as the sheep-pellets reduced to morsels. Sometimes, the dough is fine and almost homogeneous from one end of the cylinder to the other ; more often, the

piece is a sort of hardbake, in which large fragments are held together by a cement of amalgam. The baker apparently varies the more or less finished confection of her pastry according to the time at her disposal.

The thing is closely moulded in the terminal pocket of the burrow, where the walls are smoother and more carefully fashioned than in the rest of the pit. The point of the knife easily strips it of the surrounding earth, which peels like a rind or bark. In this way, I obtain the food-cylinder free of any earthy blemish.

Having done this, let us look into the matter of the egg; for the pastry has certainly been manipulated in view of a grub. Guided by what I learnt some time ago from the Geotrupes, who lodge the egg at the lower end of their pudding, in a special recess contrived in the very heart of the provisions, I expect to find Minotaurus' egg right at the bottom of the sausage. I am ill-informed. The egg sought for is not at the expected end, nor at the other end, nor at any point whatever of the victuals.

A search outside the provisions shows it me at last. It is below the food, in the sand itself, deprived of all the finikin cares dear to mothers. There is here not a smooth-walled cell, such as the delicate epidermis of the new-born grub would seem to call for, but a rough cavity, the result of a mere landslip rather than of maternal industry. The worm is to be hatched in this rude berth, at some distance from its provisions. To reach the food, it will have to demolish and pass through a ceiling of sand some millimetres thick.

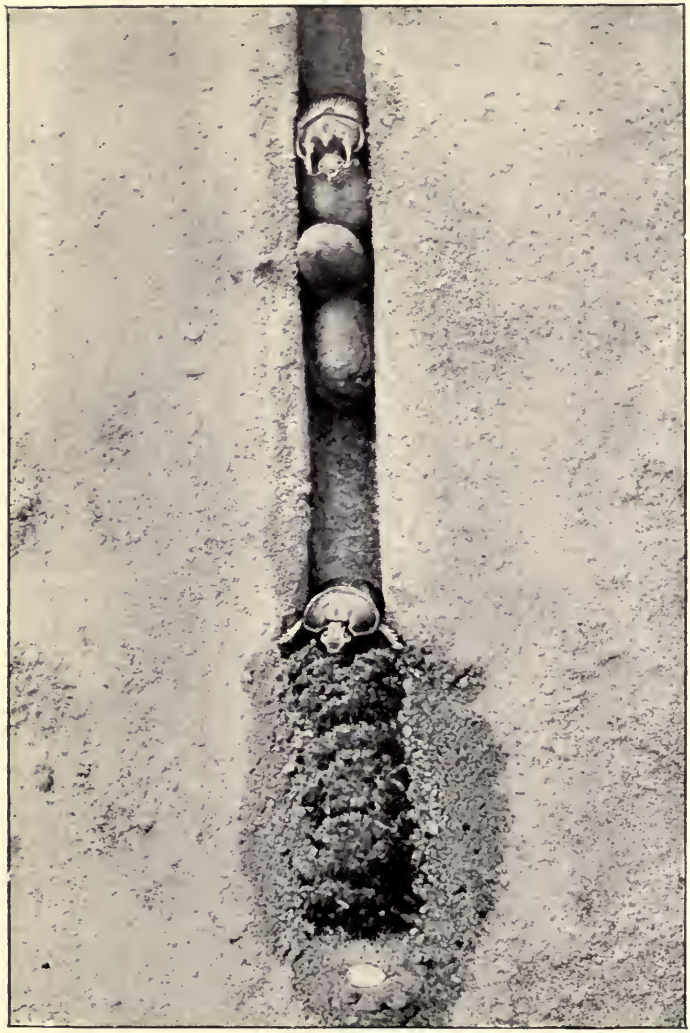
With insects held captive in an apparatus of my invention, I have succeeded in tracing the construction of that sausage. The father goes out and selects a pellet whose length is greater than the diameter of the pit. He

conveys it to the mouth, either backwards, by dragging it with his forefeet, or straight ahead, by rolling it along with little strokes of his shield. He reaches the edge of the hole. Will he hurl the lump down the precipice with one last push ? Not at all : he has plans that are incompatible with a violent fall.

He enters, embracing the pellet with his legs and taking care to introduce it by one end. On reaching a certain distance from the bottom, he has only to slant the piece slightly to make it find a support at its two ends against the walls of the channel : this because of the greater length of its main axis. He thus obtains a sort of temporary flooring suited to receive the burden of two or three pellets. The whole forms the workshop in which the father means to do his task without disturbing the mother, who is fully engaged below. It is the mill whence will be lowered the semolina for making the cakes.

The miller is well-equipped for his work. Look at his trident. On the solid basis of the corselet stand three sharp spears, the two outer ones long, the middle one short, all three pointing forwards. What purpose does this weapon serve ? At first sight, one would take it for a masculine decoration, one of so many others, of very varied forms, worn by the corporation of Dung-beetles. Well, it is something more than an ornament : Minotaurus turns his gaud into a tool.

The three unequal points describe a concave arch, wide enough to admit a spherical sheep-dropping. Standing on his imperfect and shaky floor, which demands the employment of his four hind-legs, propped against the walls of the perpendicular channel, how will Minotaurus manage to keep the elusive olive in position and break it up ? Let us watch him at work.



The Minotaurus couple engaged on miller's and baker's work.

Stooping a little, he digs his fork into the piece, thenceforth rendered stationary, for it is caught between the prongs of the implement. The fore-legs are free; with their toothed armlets they can saw the morsel, lacerate it and reduce it to particles which gradually fall through the crevices of the flooring and reach the mother below.

The substance which the miller sends scooting down is not a flour passed through the bolting-machine, but a coarse grain, a mixture of pulverized remnants and of pieces hardly ground at all. Incomplete though it be, this preliminary trituration is of the greatest assistance to the mother in her tedious job of bread-making: it shortens the work and allows the best and the middling to be separated straight away. When everything, including the floor itself, is ground to powder, the horned miller returns to the upper air, gathers a fresh harvest and recommences his shredding labours at leisure.

Nor is the baker inactive in her laboratory. She collects the remnants pouring down around her, subdivides them yet further, refines them and makes her selection: this, the tenderer part, for the central crumb; that, tougher, for the crust of the loaf. Turning this way and that, she pats the material with the battledore of her flattened arms; she arranges it in layers, which presently she compresses by stamping on them where they lie, much after the manner of a vine-grower treading his vintage. Rendered firm and compact, the mass will keep better and longer.

After some ten days of this united labour, the couple at last obtain the long, cylindrical loaf. The father has done the grinding, the mother the kneading.

I have even succeeded in watching the digging of this very deep burrow, thanks to a complicated series of

artifices which it would take too long to set forth here. The mother is at the bottom of the pit : she alone attacks the working-face, she alone digs. The male keeps at the back of his spouse. He gradually collects the rubbish and makes a load of it which he lifts with his three-pronged fork and hoists outside with much exhausting labour.

This is the moment to recapitulate Minotaurus' merits. When the great colds are over, he sets out in quest of a mate, buries himself with her and thenceforth remains faithful to her, despite his frequent excursions out of doors and the meetings to which these are likely to lead. With indefatigable zeal, he assists the burrower, herself destined never to leave her home until the emancipation of the family. For a month and more, he loads the rubbish of the excavation on his forked hod ; he hoists it outside and remains ever patient, never disheartened by his arduous feats of climbing. He leaves the comparatively easy work of the excavating rake to the mother and keeps the more troublesome task, the exhausting carriage through a narrow, very high and perpendicular gallery, for himself.

Next, the navvy turns himself into a collector of food-stuffs ; he goes after provisions, he gathers the wherewithal for his sons to live upon. To facilitate the work of his mate, who shreds, stratifies and compresses the preserves, he once more changes his trade and becomes a miller. At some distance from the bottom, he bruises and crumbles the matter found hardened by the sun ; he makes it into semolina and flour that gradually pour down into the maternal bakery. Lastly, worn out by his efforts, he leaves the house and goes to die outside, at a distance, in the open air. He has gallantly performed his duty as

a paterfamilias; he has spent himself without stint to secure the prosperity of his kith and kin.

The mother, on her side, allows nothing to divert her from her housekeeping. Throughout her working life, she never leaves her home: *domi mansit*, as the ancients used to say, speaking of their model matrons; *domi mansit*, kneading her cylindrical loaves, filling them with an egg, watching them until the exodus arrives. When the day comes for the autumnal merry-makings, she at last returns to the surface, accompanied by the young people, who disperse at will to feast in the regions frequented by the sheep. Thereupon, having nothing left to do, the devoted mother perishes.

Yes, amid the general indifference of fathers for their sons, Minotaurus displays a very remarkable zeal where his family are concerned. Forgetful of himself, refusing to be led away by the delights of spring, when it would be so pleasant to see a little country, to banquet with his fellows, to tease and flirt with his fair neighbours, he sticks to his work underground and wears himself out so as to leave a fortune to his descendants. Here is one who, when he stiffens his legs for the last time, is well entitled to say:

"I have done my duty; I have worked."

# THE TWO-BANDED SCOLIA

## CHAPTER XI

### THE TWO-BANDED SCOLIA

If strength were to take precedence of other zoological attributes, the Scoliæ would reign in the first rank, in the order of the Hymenoptera. Some of them can be compared in size with the little orange-crested northern Wren, the Kinglet, who comes down to us, to visit the maggoty buds, at the time of the first autumnal mists. The largest, the most imposing of our sting-carriers, the Humble-bee, the Hornet, cut a poor figure beside certain Scoliæ. Among this group of giants, my region boasts the Common or Garden Scolia (Scolia Hortorum, van der Lind), who exceeds four centimetres[1] in length and measures ten[2] from tip to tip of her outstretched wings, and the Hemorrhoidal Scolia (Scolia Hemorrhoïdalis, van der Lind), who vies in dimensions with the Garden Scolia and is distinguished from her, in the main, by the brush of red bristles at the tip of her belly.

A black livery, with broad yellow patches ; tough wings amber as an onion-skin and shot with purple reflections ; coarse, knotted legs, bristling with rugged hairs ; a massive build ; a powerful head, helmeted with a hard skull ; a stiff and clumsy gait ; a short, silent flight, devoid of soaring qualities : this, in few words, describes the

[1] 1½ inches.—*Translator's Note.*
[2] 4 inches.—*Translator's Note.*

appearance of the female, powerfully equipped for her severe task. That love-lorn idler, the male, is more gracefully horned, more daintily clad, more elegantly shaped, without altogether losing the character of sturdiness which is the predominant feature in his mate.

It is not without qualms that the insect-collector finds himself for the first time in the presence of the Garden Scolia. How is he to capture the commanding brute, how to protect himself against its sting ? If the effect of the sting be in proportion to the Hymenopteron's size, then a prick from the Scolia is something to be dreaded. The Hornet, once he lugs out, hurts us atrociously. What, then, would it be like if one were stabbed by this colossus ? The prospect of a swelling the size of your fist and as painful as though it were blistered by a red-hot iron passes through your mind, just as you are about to cast the net. And you refrain, you beat a retreat, only too glad not to have aroused the attention of the dangerous animal.

Yes, I confess to having quailed before my first Scoliæ, eager though I was to enrich my incipient collection with this glorious insect. Smarting recollections left behind by the Wasp and the Hornet had something to say to this excessive prudence. I say excessive, for to-day, taught by long experience, I have got the better of my former fears and, if I see a Scolia resting on a thistle-head, I have no scruples about taking her in the tips of my fingers, with no precaution of any kind, threatening though her aspect be. My pluck is only apparent, as I am pleased to inform the novice at Hymenopteron-hunting. The Scoliæ are very peaceful. Their sting is an implement of work much rather than a weapon of war : they use it to paralyze the prey intended for their family ; and only in the last

extremity do they employ it in their own defence. Moreover, the lack of suppleness in their movements enables one nearly always to avoid the sting ; and, lastly, if one were stung, the pain of the prick is almost insignificant. This absence of a bitter smart in the poison is a pretty constant fact among the game-hunting Hymenoptera, whose weapon is a surgical lancet intended for the most delicate physiological operations.

Among the other Scoliæ of my district, I will mention the middle-sized Two-banded Scolia (Scolia Bifasciata, van der Lind), whom I see yearly, in September, exploiting the manure-heaps of dead leaves arranged, for her benefit, in a corner of my yard. Let us watch her performance comfortably indoors.

After the Cerceris, it is well to study others, hunting an unarmed prey, a prey vulnerable at all points save the skull, but giving only a single prick with the sting. Of these two conditions, the Scoliæ fulfilled one, with their regulation game, the soft grub of Cetonia, Oryctes or Anoxia, according to their species. Did they fulfil the second ? I was convinced beforehand, judging from the anatomy of the victims, with its concentrated nervous system, that the sting was unsheathed but once ; I even foresaw the point in which the weapon must be thrust.

These were statements dictated by the anatomist's scalpel, without the least direct proof from observed facts. Stratagems accomplished underground escaped the eye and seemed to me bound always to escape it. How, indeed, could one hope that an animal whose art is practised in the darkness of a manure-heap should be persuaded to work in the full light of day ? I did not reckon on it in the least. Nevertheless, for conscience' sake, I tried putting the Scolia in touch with her quarry

under glass. And it was well that I did so, for my success was in the inverse ratio to my expectations. Never did beast of prey show greater zeal in attacking under artificial conditions. Every insect experimented upon rewarded me, sooner or later, for my patience. Let us watch Scolia Bifasciata at work, operating on her Cetonia grub.

The captive grub tries to escape its terrible neighbour. Turned over on its back according to its custom, it shuffles along eagerly, going round and round the glass arena. Soon, the Scolia's attention is aroused and is evinced by continual little taps of the tips of its antennæ upon the table, which now represents the customary soil. The Hymenopteron falls upon her prey and attacks the monstrous meal by the hinder end. She climbs upon the Cetonia, using the abdominal extremity as a lever. The assaulted grub does nothing but scud all the faster on its back, without rolling itself into a defensive posture. The Scolia reaches the front part, after falls and accidents that vary greatly, according to the degree of tolerance of the grub, her temporary mount. With her mandibles, she nips a point on the upper surface of the thorax ; she places herself across the grub, curves herself into an arch and tries to touch with the point of her belly the region where the sting is to be darted. The arch is a little too short to embrace almost the whole circuit of the corpulent prey, for which reason the efforts and attempts are made over and over again, at great length. The tip of the abdomen makes untold exertions, applies itself here, there and elsewhere and, as yet, stops nowhere. This tenacious searching in itself proves the importance which the paralyzer attaches to the spot at which its bistoury is to enter.

Meanwhile, the grub continues to move along on its

1. The Common or Garden Scolia.
2. The Two-banded Scolia.
3. Grub of *Cetonia Aurata* progressing on its back.
4. The Two-banded Scolia paralyzing a Cetonia grub.
5. Cetonia grubs progressing on their backs, with their legs in the air; two are in a resting position, rolled up.

back. Suddenly, it buckles and, with a jerk of the head, flings the enemy to a distance. Undaunted by all her failures, the Hymenopteron stands up, brushes her wings and recommences the assault of the colossus, almost always by clambering on the grub by the rear extremity. At last, after any number of fruitless attempts, the Scolia succeeds in attaining the proper position. She lies across the grub ; her mandibles hold a point of the thorax on the dorsal face tight-gripped ; her body, curved into an arch, passes under the grub and reaches the neighbourhood of the neck with the tip of the belly. Placed in grave danger, the Cetonia twists, buckles, unbuckles, turns and writhes. The Scolia does not interfere. Holding her victim in a close embrace, she turns with it, allows herself to be dragged above, below, aside, at the mercy of the contortions. So fierce is her determination that I am now able to remove the glass bell and watch the details of the drama in the open.

Soon, notwithstanding the tumult, the tip of the Scolia's belly feels that the suitable point is found. Then and not till then is the dart unsheathed. It is driven home. The thing is done. The grub, but now active and swollen, suddenly becomes inert and limp. It is paralyzed. Henceforth, all movement ceases, save in the antennæ and mouth-pieces, which will continue for a long time to declare a remnant of life.

The place of the wound has never varied in the series of struggles under the glass bell : it occupies the middle of the dividing line between the prothorax and the mesothorax, on the ventral surface. Let us observe that the Cerceris, who operates upon Weevils, which insects have a concentrated nervous chain like that of the Cetonia grub, inserts her sting at the same point. The similarity of the

nervous organization occasions a similarity of method. Let us observe also that the sting of the Scolia remains for some time in the wound and rummages with a pronounced persistency. To judge by the movements of the tip of the abdomen, one would say that the weapon is exploring and selecting. Free to turn about as it pleases within narrow limits, the sting's point is probably searching for the little bundle of nerves which it must prick, or at least sprinkle with poison, in order to obtain a withering paralysis.

I will not end my report of the duel without relating a few more facts, of minor importance. The Two-banded Scolia is an ardent persecutor of the Cetonia. At one sitting, the same mother stabs three grubs, one after the other, before my eyes. She refuses the fourth, perhaps through fatigue, or because her poison-phial is exhausted. Her refusal is but temporary. The next day, she begins anew and paralyzes two worms ; the following day again, but with a zeal that diminishes from day to day.

The other predatory insects that go on long hunting-expeditions embrace the prey which they have rendered lifeless, drag it, convey it, each in its own fashion, and, laden with their burden, long try to escape from the bell and to reach the burrow. Disheartened by vain attempts, they abandon it at last. The Scolia does not move her prey, which lies indefinitely on its back at the spot of sacrifice. After drawing her dagger from the wound, she leaves her victim alone and starts fluttering against the walls of the bell, without troubling about it further. Things must happen in the same way in the manure-heap, under normal conditions. The paralyzed morsel is not carried elsewhither, to a special cellar : where the struggle occurred, there it receives, on its spread

belly, the egg whence the consumer of the succulent dainty will presently emerge. This saves the expense of a house. It goes without saying that the Scolia does not lay under glass : the mother is too prudent to expose her egg to the dangers of the open air.

A second detail strikes me : the fierce persistency of the Scolia. I have seen the fight prolonged for a good quarter of an hour, with frequent alternations of successes and reverses, before the Hymenopteron achieved the requisite position and reached with the tip of her belly the point at which the sting must enter. During her assaults, which are resumed as soon as repelled, the aggressor repeatedly applies the extremity of her abdomen against the grub, but without unsheathing ; for I should perceive this by the start of the animal injured by the prick. The Scolia, therefore, does not sting the Cetonia anywhere until the desired point offers beneath the weapon. The fact that no wounds are made elsewhere is not in any way due to the structure of the grub, which is soft and penetrable at all points, except the skull. The spot sought by the sting is no less well-protected than the others by the dermal wrapper.

In the struggle, the Scolia, curved archwise, is sometimes caught in the vice of the Cetonia, which forcibly contracts and buckles itself. Heedless of the rough embrace, the Hymenopteron does not let go with either her teeth or her ventral tip. Then follows a confused scuffle between the two locked insects, of which first one and next the other is on the top. When the grub succeeds in ridding itself of its enemy, it unrolls itself afresh, stretches itself at full length and proceeds to paddle along on its back with all possible speed. Its defensive artifices amount to no more than this. At an earlier

period, when I had not yet seen for myself and was obliged to take probability for my guide, I was willing to grant it the trick of the hedgehog, who rolls himself into a ball and defies the dog. I thought that, doubled up, with a force which my fingers had some difficulty in overcoming, it would in like manner defy the Scolia, who was powerless to unroll it and disdainful of any point but that of her choice. I wished the grub to possess and I believed that it did possess this very simple and efficacious means of defence. But I had too great confidence in its ingenuity. Instead of copying the hedgehog and remaining contracted, it flees with its belly in the air ; foolishly, it adopts the very posture which allows the Scolia to make the assault and to reach the point at which the fatal blow is struck.

Let us pass on to others. I have just captured an Interrupted Scolia (Colpa Interrupta, Latr.), exploring the sands, no doubt in quest of game. It is important to make use of her as soon as may be, before her ardour has been cooled by the tedium of captivity. I know her prey, the grub of Anoxia Australis; I know, from my old habits of digging, the spots beloved by the worm : the sand-dunes heaped by the wind at the foot of the rosemary-shrubs on the slopes of the neighbouring hills. It will be hard work finding it, for nothing is rarer than a common thing, when it is needed in a hurry. I call in the aid of my father, an old man of ninety, but still straight as a wand. Shouldering a shovel and a three-pronged *luchet*, we set out under a sun in which you could cook an egg. Exerting our feeble powers in turns, we cut a trench in the sand where I hope to find the Anoxia. My hopes are not disappointed. In the sweat of my brow —never was truer word spoken—after shifting and sifting

through my fingers at least two cubic yards of sandy soil, I am the fortunate possessor of two grubs. Had I not wanted them, I should have dug them up by the handful! However, my lean and costly harvest is sufficient for the moment. To-morrow, I shall send stronger arms to continue the digging.

And now let us repay ourselves for our trouble by witnessing the drama under glass. Heavy and clumsy in her ways, the Scolia moves slowly round the arena. At the sight of the game, her attention wakes up. The fight is heralded by the same preparations as those displayed by the Two-banded Scolia: the Hymenopteron polishes her wings and taps the table with the tips of her antennæ. And now, up, lads, and at 'em! The attack begins. Unfit to move over a flat surface, because of its short, weak legs; lacking, moreover, the Cetonia's eccentric means of locomotion on its back, the big-bellied worm does not dream of running away: it rolls itself up. The Scolia, with her powerful nippers, grabs its skin, now at once place, now at another. Buckled into an arch whose two ends almost meet, she strives to thrust the tip of her belly into the narrow opening of the volute formed by the grub. The fight is conducted quite calmly, without hard blows and with varying fortunes. It represents the obstinate attempt of a live split ring trying to slip one of its ends into another live split ring, which displays an equal obstinacy in remaining closed. The Scolia holds the game in subjection with her legs and mandibles; she makes her attempt first on one side and then on the other, without succeeding in unrolling the torus, which becomes the more contracted the more it feels itself in danger. The actual circumstances make the operation difficult: the prey slips and rolls over the table, when the insect

goes for it too briskly; points of support are wanting and the sting cannot reach the desired spot; for over an hour, one vain attempt follows upon the other, divided by spells of rest, during which the two adversaries look like two narrow rings wound one inside the other.

What ought the sturdy Cetonia grub to do in order to defy the Two-banded Scolia, who is nothing like so strong as her victim? Imitate the Anoxia, of course, and remain rolled up like a hedgehog until the enemy retreats. It tries to flee, unrolls itself and thus causes its own undoing. The other does not budge from its defensive posture and resists successfully. Is this due to acquired prudence? No, but to the impossibility of acting otherwise on the polished surface of a table. Heavy, obese, weak-legged, bent into a hook after the manner of the common white maggot, the Anoxia grub is unable to shift its position on a smooth surface; it flounders painfully, lying on its side. What it wants is the shifting soil wherein, using its mandibles as a spade, it digs and buries itself.

Let us try if sand will shorten the battle, of which the end does not yet seem in sight after an hour's waiting. I lightly sprinkle the arena. The attack is resumed more fiercely than ever. The grub, feeling the sand, its natural dwelling-place, now also tries to slip away, the reckless one! What did I tell you? Its torus does not represent acquired prudence, but the necessity of the moment. The harsh experience of past misfortunes has not yet taught it the precious advantage which it would derive from its volute kept closed as long as danger lasts. Besides, not all are equally cautious on the firm support of my table. The biggest even seem ignorant of what they understood so well in their youth: the art of self-defence by rolling one's self in a ball.

I take up my story again with a fine-sized quarry, less liable to slip under the Scolia's pushes. The grub, when assailed, does not curl up, does not contract into a ring, like its predecessor, which was younger and but half its size. It tosses about clumsily, lying on its side, half-opened. Its only attempt at defence is to wriggle ; it opens, closes and reopens its big mandibular hooks. The Scolia grabs it at random, winds her rough, hairy legs around it and, for nearly fifteen minutes, strives her hardest atop of the rich dainty.

At last, after a series of not very riotous affrays, the favourable position is gained, the propitious moment arrives and the sting is planted in the grub's thorax, at a central spot, under the neck and level with the fore-legs. The effect is instantaneous : total inertia, save in the appendages of the head, the antennæ and mouth-pieces. I find the same results, the same prick at a precise, invariable spot, among my different operators, captured from time to time with a successful stroke of the net.

Let us say, in conclusion, that the attack delivered by the Interrupted Scolia is much less fiery than that of her two-banded sister. This rough, sand-digging Hymenopteron has a clumsy gait and stiff, almost automatic movements. She does not easily repeat her dagger-thrust. Most of those with whom I experimented refused a second victim on the day after their exploits and on the following day. Half-asleep, they grew excited only when stimulated through my teasing them with a straw. Nor does the Two-banded Scolia, that more agile, more enthusiastic huntress, invariably unsheath when invited so to do. All those Nimrods are liable to moments of inaction which the presence of a new prey will not succeed in disturbing.

The Scoliæ have taught me no more than I have said, for lack of subjects belonging to other species. No matter : the results obtained constitute, to my mind, no small triumph. After seeing the Scoliæ at work, I said to myself, guided merely by the anatomical structure of the victims, that the grubs of Cetonia, of Anoxia, of Oryctes must be paralyzed with a single prick of the sting ; I even specified the point at which the dagger had to strike, a central point in the immediate neighbourhood of the fore-legs. Of the three kinds of sacrificers, two allowed me to be present at their surgical operation, which the third, I am certain, will not contradict. In both cases, a single blow of the lancet ; in both cases, an inoculation with the poison at the place settled in advance. No calculator in an observatory could show greater accuracy in foretelling the position of his planet. An idea may be considered proved when it attains this mathematical anticipation of the future, this positive knowledge of the unknown. When will the extollers of chance achieve a like success ? Order calls for order ; and chance has no rule.

# THE RINGED CALICURGUS

## CHAPTER XII

### THE RINGED CALICURGUS

The non-cuirassed victims, pervious to the sting over almost the whole of their body, such as Common Caterpillars and "Land-surveying" Caterpillars, Cetonia and Anoxia grubs, whose sole means of defence, apart from their mandibles, consists in rollings and contortions, summoned another prey to my glass bell: the Spider, almost as ill-protected, but armed with formidable poison-fangs. How, more particularly, does the Ringed Calicurgus, or Pompilus, set to work to deal with the black-bellied Tarantula, the terrible Lycosa Narbonnensis, who slays mole and sparrow with a bite and imperils the life of man? How does the bold Pompilus overcome an adversary stronger than herself, better-endowed in virulence of poison and capable of making a meal of her assailant? Among the hunting insects, none faces such disproportionate contests, in which appearances seem to point to the aggressor as the prey and to the prey as the aggressor.

The problem deserved patient study. True, judging by the Spider's structure, I anticipated a single stab in the centre of the thorax; but this did not explain the victory of the Hymenopteron, emerging safe and sound from her encounter with a quarry of that description. The matter must be looked into. The chief difficulty is the